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# FIRST ANNUAL REPORT

OF THE

# VERMONT STATE BOARD

OF

# Agriculture, Manufactures and Mining,

FOR

THE YEAR 1872.

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BY PETER COLLIER,
SECRETARY OF THE BOARD.

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MONTPELIER:
J. & J. M. POLAND'S STEAM PRINTING ESTABLISHMENT.
1872.

# AN ACT ESTABLISHING A BOARD OF AGRICULTURE, MINING AND STATISTICS.

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It is hereby enacted by the General Assembly of the State of Vermont:

SEC. 1. The governor of the state, the president of the state agricultural college, and six other persons, who shall be nominated by the governor and confirmed by the senate, shall constitute the VERMONT STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING, and shall receive the same *per diem* compensation for time employed in the duties hereinafter specified as members of the general assembly, and the actual rates of fare paid by them to and from the place of meeting. In case of death, resignation, or removal from the state of any member, or vacancy otherwise arising, the governor shall fill such vacancy as in other cases.

SEC. 2. The first meeting of the members of the board shall be held on the call of the governor, when they shall complete the organization of the board by appointing a secretary, who shall be *ex officio* a member of the same, and shall receive for his services a salary of five hundred dollars per annum, with the actual expenses of postage, stationery and other office expenses, but no allowance for personal expenses.

SEC. 3. The term of office of the appointed members shall expire on the first day of November, A. D. 1872, and biennially thereafter.

SEC. 4. The board shall hold at least one business meeting during each year, and as many more as they may deem

expedient; and shall, by themselves or through their secretary, make statistical and other investigations and recommendations in regard to the condition of agriculture, horticulture, manufactures and mining, as they may deem conducive to the general interests of the state, and cause the same to be published in the same manner as is by law provided for the publishing of the report of the state board of education.

SEC. 5. They shall also hold at least one public meeting of not more than three days' duration, each year, for the acquisition and dissemination of knowledge on the subject matter of their investigations, by addresses, essays and discussions, in which the people of the state shall be invited to participate, and may incorporate any of these papers of sufficient value to warrant publication into their report heretofore provided for.

SEC. 6. The entire expense of the board, including salaries and printing, shall not exceed twenty-five hundred dollars per annum.

Approved, November 22, 1870.

# MEMBERS OF THE BOARD

OF

# AGRICULTURE, MANUFACTURES AND MINING.

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EX-OFFICIIS.

HIS EXCELLENCY JOHN W. STEWART.
* JAMES B. ANGELL, *Pres. State Ag. Coll.*
PETER COLLIER, *Secretary of the Board.*

APPOINTED BY GOVERNOR AND SENATE.

HON. A. B. HALBERT, *Essex.*
HON. CHARLES H. HEATH, *Plainfield.*
† HON. FREDERICK HOLBROOK, *Brattleboro.*
HON. PITT W. HYDE, *Castleton.*
Z. E. JAMESON, ESQ., *Irasburgh.*
HON. NOAH B. SAFFORD, *White River Junction.*

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* During the summer of 1871 Pres. Angell was succeeded by Matthew H. Buckham as President of the State Agricultural College.

† Hon. Frederick Holbrook declined his appointment as member.

## SECOND MEETING OF THE BOARD.

The Board met in the parlors of the American Hotel, February 9th, 1871, all the members being present. Mr. Holbrook's successor not having been appointed, his place alone was vacant.

At the request of the Governor the Secretary made the following report, presenting some of the details of work before the Board, which appeared to him to be practicable.

### AGRICULTURE.

1. To supplement other organizations for similar objects in the State, so far as we may do so and preserve our individuality, but to supplant nothing.

2. To co-operate with county and town societies and through them secure some uniform and systematic plan of work throughout the State.

3. To suggest to dairymen, farmers, and stock breeders certain definite experimental problems.

4. To procure analyses of all fertilizers (natural or artificial) for sale throughout the State, and publish them in full with their relative and commercial values. And to secure protection against frauds by legislative or other action.

5. In accordance with the provisions of the act, to hold at least one annual meeting, at some central point in the State, for the purpose of discussion and the reading of papers.

6. Under the auspices of the local societies, and co-operating with them, to hold meetings of the Board from time to

time, in the various counties, of the same general character as the State meetings.

7. To publish from time to time the more valuable papers presented, together with statistics collected, and distribute the same among the people separately or in the annual report.

8. That the name of the officers of all county and town Agricultural and Horticultural societies, and Farmers' or Dairymen's clubs, throughout the State, be obtained by the Secretary, through whom the papers from time to time printed may be distributed.

### MINING.

1. Gathering statistics as to the various mining operations and metallurgical industries of the State;—chiefly in marble, granite, soap-stone, slate, copper and iron, and comparing our own resources with those of other sections of the country, as to extent and profit.

2. Calling attention to ores and deposits occurring in the State, whether utilized at present or not.

3. Especially in those sections where these interests are important, to prepare papers and discussions calling attention to the kinds of ores in the vicinity, their metallurgical or economic value, and the methods of readily testing them.

### MANUFACTURES.

1. Gathering information and statistics as to the various kinds of manufactures, their extent and prosperity.

2. Collection of statistics as to the water power of the State, occupied and unoccupied, and its accessibility.

3. Calling attention to supplies of raw and waste material in the State, which is unused.

4. Inquiry into the best method of promoting manufactures, without imperilling other public interests.

The Secretary, in further explanation of his views, urged the importance of the several points above enumerated, and the whole matter was then laid before the Board. After a general discussion, the report and suggestions of the Secretary were approved, and, by a vote of the Board, adopted as the basis of action, subject to any future modification which might appear advisable.

Upon motion of Mr. Heath, it was resolved that such inquiries be made by the Secretary in regard to a Hydrographic Survey of the State as he (the Secretary) should think expedient.

The Governor suggested the importance of the Secretary preparing an address upon the "object and aims of the Board," which suggestion was universally endorsed.

Mr. Jameson presented letters from the President and Secretary of the Caledonia County Agricultural Society, extending a cordial invitation to the Board to meet with them at St. Johnsbury. The invitation was accepted, and the time of meeting was left at the discretion of the Secretary.

A motion was carried that the state meeting be held at Montpelier; also that four other meetings be held during the year, at such times and places as the Governor and Secretary should decide. The securing of accurate press reports and the details of these several meetings, was left at the discretion of the Secretary.

After considerable discussion, the meeting adjourned, subject to a call from the Secretary.

PETER COLLIER, *Sec'y.*

Burlington, Feb. 9, 1871.

## THIRD MEETING OF THE BOARD.

The Board met at the American Hotel in Burlington, January 25th, 1872, at which every member was present but Mr. Halbert.

Mr. Hyde stated the main object of the meeting to be the appointment of two delegates from the Board to attend the Agricultural Convention called by the Commissioner of Agriculture, to be held in the city of Washington, February 15th. Mr. Hyde moved that the Secretary be appointed as one of the delegates, and Mr. Heath moved that Mr. Safford be appointed as the other delegate, and these gentlemen were elected.

Upon motion of Mr. Hyde, the Secretary was authorized to remit, to those furnishing papers to be read at meetings of the Board at the several meetings, their expenses for travel and during attendance. Upon motion of Mr. Heath, the Secretary was requested to procure and cause to be deposited in the Cabinet at Montpelier, and of the State Agricultural College, specimens of all grasses native to Vermont, and of all cereals grown within the state.

The meeting then adjourned to attend the general meeting being held in the Court House.

PETER COLLIER, *Sec'y.*

Burlington, January 25th, 1872.

# PUBLIC MEETINGS OF THE BOARD

OF

# AGRICULTURE, MANUFACTURES AND MINING.

In accordance with the proposed plan, and in compliance with invitations received, the Board has held meetings for the reading of papers upon the agricultural, manufacturing and mining interests of the state, at the following places, and in the following order:

St. Johnsbury, March 9th and 10th, 1871.
Brandon, June 8th and 9th, 1871.
Randolph, June 15th and 16th, 1871.
Burlington, January 24th and 25th, 1872.
Middlebury, February 7th and 8th, 1872.
Montpelier, February 21st and 22d, 1872.
St. Albans, March 6th and 7th, 1872.
Newport, August 6th and 7th, 1872.
Craftsbury, August 8th and 9th, 1872.

Many other invitations have been extended to the Board which could not well be accepted, but which show that the labors of the Board in this direction have been appreciated by the people. Although want of information, as to the true character of the meetings to be held, has in nearly every instance prevented a full attendance upon the start, still, as the meetings progressed, each successive session brought increasing numbers, and developed an increasing interest on the part of the people in attendance.

At each of the above meetings there were held from three to five sesssions, and generally a discussion, more or less prolonged, followed each paper presented. Nearly every one of the papers read has been specially prepared for these meetings, and representing as they do the practical views of our own citizens for the most part, will be read with interest and profit. Most of them, with the salient points elicited during their discussion, will be found in this volume.

# FIRST PUBLIC MEETING

OF THE

STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*St. Johnsbury, Thursday and Friday, March 9th and 10th*, 1871,

UPON INVITATION OF THE

CALEDONIA COUNTY AGRICULTURAL SOCIETY.

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Severe rains had rendered the roads heavy, and the weather very unfavorable for a full attendance.

The meeting was called to order by Chas. A. Sylvester, Esq., President of the Caledonia County Agricultural Society, at the invitation of which this meeting was held. The number present was not large, but gradually increased during this and subsequent sessions. Those present were evidently almost exclusively of the most substantial and intelligent class of farmers, men who love their business, study it, and are constantly successful in its prosecution.

Messrs. Safford, Jameson and Collier represented the Board during the meeting. Four sessions were held and the following papers were read:

## THURSDAY AFTERNOON.

"The Object and Aim of the Board," Peter Collier, Secretary, Burlington.

"Vermont as a Home," Z. E. Jameson, Irasburgh.

### THURSDAY EVENING.

"Difficulties of Fruit Raising in Vermont," Dr. T. H. Hoskins, Newport, Editor *Vermont Farmer*.

### FRIDAY FORENOON.

"Fertility of Soils—how Lost—how Restored," Jonathan Lawrence, Passumpsic.

### FRIDAY AFTERNOON.

"Commercial Fertilizers," A. B. Pringle, Wells River.

"Nutrition of Plants," Peter Collier, Burlington.

Before the adjournment, a resolution was offered, and passed unanimously, thanking the Board and its Secretary for their very successful efforts to make this, its first meeting, profitable and acceptable to those it was designed to benefit. A desire was also expressed that the papers read and the discussions had should be printed in all the newspapers of the State.

## SECOND PUBLIC MEETING

OF THE

STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*Brandon, Thursday and Friday, June 8th and 9th,* 1871,

UPON INVITATION OF THE

FARMERS AND MECHANICS' CLUB.

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The presence of an active club at this place insured a full attendance during the meeting, and a vigorous discussion was maintained throughout. President Angell, Messrs. Hyde, Jameson and Collier of the Board were present.

Judge Ezra June, Vice President of the Brandon Farmers' Club, was called to preside, and made a brief salutatory address, welcoming the Board to Brandon, and to the hospitalities of the Brandon Farmers' and Mechanics' Club, and introduced President Angell, of the University of Vermont and State Agricultural College, and of the State Board of Agriculture, to the chair.

Four sessions were held and the following programme was followed:

### THURSDAY AFTERNOON.

Introductory address by Judge Ezra June, Brandon.

"Objects and Aims of the Board," by President James B. Angell, of the University of Vermont.

"Agricultural Societies," by Z. E. Jameson, Esq., Irasburgh.

### THURSDAY EVENING.

"Birds as related to Agriculture," by Prof. George H. Perkins, Burlington.

"Size no Measure of Merit to Vermont Farmers," by Albert Chapman, Esq., Middlebury, Agricultural Editor of Middlebury *Register*.

### FRIDAY FORENOON.

"Meteorological Observations," by Rev. R. G. Williams, Castleton.

"What Breed of Horses shall we Raise?" by Colonel E. S. Stowell, Cornwall.

### FRIDAY AFTERNOON.

"Meteorology," by Dr. Hiram A. Cutting, Lunenburgh, State Geologist.

"Hybridization and Selection in Plants," by C. G. Pringle, Esq., Charlotte.

"Commercial Fertilizers," by Peter Collier, Secretary.

The audience throughout was composed of the best citizens and most intelligent farmers of the vicinity, who manifested a most earnest and active interest in the proceedings; all present were gratified and felt well repaid for the time spent at the sessions. And as was said by one of the speakers at the close, "There is no doubt but that much good has resulted from the meeting, and that the usefulness of the Board has been demonstrated to a large circle of those most interested in its continuance with enlarged resources and powers."

# THIRD PUBLIC MEETING

OF THE

STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*Randolph, Thursday and Friday, June 15th and 16th, 1871,*

UPON

INVITATION OF THE FARMERS' CLUB OF THAT PLACE.

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The same cause which operated so successfully at Brandon, viz: the existence of a live club of Farmers, caused the meeting here to be quite successful, both in numbers present during the sessions and in the character and vigor of discussions.

Governor Stewart, Messrs. Heath, Halbert, Jameson and Collier were present as members of the Board.

Four sessions were held, and the following was the programme of the exercises, Governor Stewart presiding during the meeting:

## THURSDAY AFTERNOON.

Opening Address by Governor Stewart.

"Meteorology"—Dr. Hiram A. Cutting, Lunenburgh.

## THURSDAY EVENING.

"The Management of Woodlands"—George F. Nutting, Randolph.

"Farm Buildings and their Relation to Husbandry"—Z. E. Jameson, Irasburgh.

### FRIDAY FORENOON.

"Plows and Plowing and Farm Implements"—J. J. Washburn, Randolph.

"The Great Wants of Vermont Farmers"—J. P. Foster, Passumpsic.

### FRIDAY AFTERNOON.

"Birds as Related to Agriculture"—Prof. George H. Perkins, Burlington.

"Our Manufacturing Industries"—Hon. C. H. Heath, Plainfield.

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## FOURTH PUBLIC MEETING

OF THE

## STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*Burlington, Wednesday and Thursday, Jan. 24th and 25th,* 1872.

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This meeting, though thoroughly advertised, failed to call out as full an attendance of farmers as it deserved. The audience consisted largely of the citizens of Burlington, attracted to the meetings by the eminent reputation of those advertised to present papers. Every member of the Board was in attendance, and five sessions were held. The following was the programme of the meeting:

### FIRST DAY—WEDNESDAY.

2.30 P. M. Opening address by President Buckham, of the University of Vermont and State Agricultural College.

Paper by Dr. Hiram A. Cutting, State Geologist of Vermont. Subject: Economic Value of the various Metallic Ores of Vermont.

Paper by J. E. Manley, Esq., of West Rutland. Subject: The Deposits of Marble in Rutland County, with History of the Marble Industry of Vermont and Statement of Comparative Values.

Paper by Hon. Roswell Farnham, of Bradford, Vt. Subject: Copper Mines and Mining of Orange County, Vt.

### EVENING.

7.30 P. M. Paper by Professor Samuel W. Johnson, of New Haven, Conn. Subject: "Exhaustion of Soils," followed by discussion of the subject, open to all present.

Paper by O. C. Wait, Secretary of the Vermont Bee-Keepers' Association. Subject: "Advantages of Bee-keeping."

### SECOND DAY—THURSDAY FORENOON.

9.30 A. M. Remarks by Hon. John W. Stewart, Governor of Vermont.

Paper by Dr. T. H. Hoskins, of the *Vermont Farmer*. Subject: "Modifications of New England Husbandry made necessary by Western Competition."

Paper by Henry Hall, Esq., of Rutland, Vt. Subject: "History of Agriculture and Manufactures in Vermont."

### AFTERNOON.

2.30 P. M. Paper by Professor S. W. Johnson. Subject: "Rotation of Crops," followed by discussion.

Paper by Harmon Northrup, Esq., Fairfield. Subject: "Making Maple Sugar."

## EVENING.

7.30 P. M. Paper by Rev. John Newman, D. D., Poultney. Subject: "Agricultural Ethics."

Paper by Henry Lane, Esq., of Cornwall. Subject: "Pear Culture in Vermont."

Paper by Professor Peter Collier, Secretary of the State Board of Agriculture. Subject: "Commercial Fertilizers."

In speaking of this meeting the *Free Press & Times* said: "It was a full and rich programme which was presented, which no farmer could afford to lose. The Board of Agriculture is run for the benefit of nobody but the people; and they should make the most of it. We think it would be the unanimous testimony of all who attended the various sessions, that it has been an exceedingly valuable meeting; and that the State Board is doing very important and beneficial work, in securing and giving to the people such stores of valuable information. The presence of Prof. Johnson lent especial interest and value to the occasion, and the Burlington meeting must be set down as among the best of its kind thus far held in our State."

# FIFTH PUBLIC MEETING

OF THE

STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*Middlebury, Wednesday and Thursday, February 7th and 8th,* 1872.

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During this meeting four sessions were held, and the attendance pretty good. Messrs. Jameson and Collier represented the Board. The following was the programme:

## WEDNESDAY AFTERNOON.

Address of Welcome, by Hon. James M. Slade, Middlebury.

Paper by E. R. Towle, Esq., Agricultural Editor St. Albans *Messenger*. Subject: "How to make Farm Life Pleasant."

Paper by Z. E. Jameson, Esq., Irasburgh. Subject: "Necessity of Success in Book Farming."

Paper by Dr. T. H. Hoskins, "*Vermont Farmer*." Subject: "Vermont as an Agricultural State."

## WEDNESDAY EVENING.

Paper by Henry Hall, Esq., Rutland. Subject: "History of Manufactures and Agriculture in Vermont."

Paper by F. D. Douglas, Esq., Whiting. Subject: "Agriculture as a Field for Human Development."

## THURSDAY FORENOON.

Paper by C. G. Pringle, Esq., Charlotte. Subject: "Fruit Growing in the Champlain Valley."

Paper by Z. E. Jameson, Esq., Irasburgh. Subject: "Orcharding."

### THURSDAY AFTERNOON.

Remarks by Peter Collier, Secretary, on "Nutrition of Plants."

Paper by Prof. H. M. Seely, Middlebury. Subject: "Relation of Science to Agriculture."

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## SIXTH PUBLIC MEETING

OF THE

## STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*Montpelier, Wednesday and Thursday, February 21st and 22d,* 1872.

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By invitation of the Washington County Agricultural Society, a meeting was held in Montpelier, February 21st and 22d.

Messrs. Heath, Jameson and Collier of the Board were present, and four sessions were held, and ten papers read.

Although the weather was cold and inclement, the attendance was unusually large.

The following was the order of exercises:

### WEDNESDAY AFTERNOON.

Introductory Address by Hon. Chas. H. Heath, Plainfield.

Pear Culture in Vermont, by Hon. Henry Lane, Cornwall.

The Butter Dairy, by D. B. Wheelock, Barre.

Orcharding, by E. E. Andrews, Esq., Berlin.

WEDNESDAY EVENING.

"The Necessity of Success in Book Farming," by Z. E. Jameson, Esq., Irasburgh.

"Grass Culture," by Stephen P. Joslin, Waitsfield.

THURSDAY FORENOON.

"Granite Quarries," by Dr. J. S. Spaulding, Barre.

"Vermont as an Agricultural State," by Dr. T. H. Hoskins, Newport, Editor *Vermont Farmer*.

"The Manufacture of Maple Sugar," by Leander Coburn, Esq., East Montpelier.

THURSDAY AFTERNOON.

"The Horse Hoe," by John Ross, Esq., Northfield, Massachusetts.

"The Relation of Science to Agriculture," by Prof. Henry M. Seely, Middlebury.

"Commercial Fertilizers," by Peter Collier, Secretary.

Before adjournment, Hon. John Gregory, of Northfield, offered the following resolution, which was unanimously adopted:

*Resolved*, That the farmers of Washington County return their hearty thanks to those gentlemen from abroad, as well as to those from this county, who have read papers or engaged in discussions at this meeting, for the valuable information which they have imparted.

It was a most satisfactory meeting, and better attended than any previous one. The papers generally were of the highest interest, and the discussions lively and to the point. Great credit was due to the active co-operation of the Washington County Society with Mr. Heath of the Board, in making requisite preparations and securing so many excellent papers and such a satisfactory attendance.

## SEVENTH PUBLIC MEETING

OF THE

## STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*St. Albans, Wednesday and Thursday, March 6th and 7th,* 1872.

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By invitation of the Franklin County Agricultural Society, the Board held a meeting at St. Albans, March 6th and 7th. An exceedingly severe snow storm having completely blockaded many of the roads, many were prevented from attending the meetings.

Messrs. Jameson and Collier were present from the State Board, and the following was the list of papers and order of exercises:

### WEDNESDAY AFTERNOON.

Address of welcome by Col. Albert Clarke, St. Albans, Editor St. Albans *Messenger.*

"Marble Industry of Swanton," by George Barney, Esq., Swanton.

"Farmers' Sons Leaving Home," by O. C. Wait, Esq., Georgia, Secretary Bee-Keepers' Association.

### WEDNESDAY EVENING.

"The Origin of the St. Albans Butter Market," by Dr. R. R. Sherman, St. Albans.

### THURSDAY FORENOON.

"The Advantages of Bee Keeping," by O. C. Wait, Esq., Georgia.

"What Breed of Cattle shall we Raise?" by Albert Chapman, Esq., Middlebury, Agricultural Editor Middlebury *Register*.

"The Future of Vermont Farmers," by Rev. G. F. Wright, Bakersfield.

THURSDAY AFTERNOON.

"Production of Grass for Hay," by E. R. Towle, Esq., West Berkshire, Agricultural Editor St. Albans *Messenger*.

"Commercial Fertilizers," by Peter Collier, Secretary.

At the time for adjournment, Albert Clarke, Esq., of St. Albans, offered a vote of thanks to the Board and to the speakers from abroad, which was unanimously passed, and the meeting adjourned.

Although held during one of the worst storms ever known in this State, this meeting, especially on the second day, was well attended, and great interest was evidently felt in the proceedings. Much credit is due to those engaged in preparing for the meeting, and especially to Col. Clarke and Mr. Towle of the *St. Albans Messenger*, both of whom labored indefatigably to make it a success. We believe that the farmers who attended were well pleased with the plan of these meetings, and that a second one in Franklin county would be attended by large numbers.

## EIGHTH PUBLIC MEETING

OF THE

STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*Newport, Tuesday and Wednesday, August 6th and 7th,* 1872.

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By invitation of the Orleans County Agricultural Society, a meeting was held at Newport, which, owing to the excitement incident to a local convention, and the pressing business of the farmers, was very poorly attended. The ill success of this meeting seems to demonstrate the wisdom of holding future meetings of the Board during the winter months.

Messrs. Jameson and Collier were present, from the Board, and the following papers were read and discussed during the three sessions:

TUESDAY AFTERNOON.

"The Influence of Climate on Man," by Dr. Henry Boynton, Woodstock.

WEDNESDAY FORENOON.

"Patrons of Husbandry," by Eben Thompson, Esq., North Danville.

"The Farm and The Common School," by Jonathan Lawrence, Esq., Passumpsic.

"Farmers' Sons and what shall they Study," by J. C. Kennedy, Esq., Troy.

### WEDNESDAY AFTERNOON.

"Weeds," by C. G. Pringle, Esq., Charlotte.

"The True Position of the Agriculturist," by Ira D. R. Collins, Esq., Craftsbury.

"Grass," by Z. E. Jameson, Esq., Irasburgh.

An earnest request was made that the Board should again consent to visit this vicinity, at some time more favorable to the farming community, when a full attendance was assured the Board.

## NINTH PUBLIC MEETING

OF THE

STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

HELD AT

*Craftsbury, Thursday and Friday, August 8th and 9th,* 1872.

Although this meeting was, in point of numbers present, a marked improvement upon the Newport meeting, still the very pressing work in the fields prevented many from coming. Messrs. Jameson and Collier of the Board were present, and five sessions were held. The following was the programme of the meeting:

### THURSDAY AFTERNOON.

"Advantage of Thorough Education to Farmers," by Rev. Horace Herrick, Wolcott.

### THURSDAY EVENING.

"Commercial Fertilizers," by Peter Collier, Secretary.

### FRIDAY MORNING.

"Grass," by Z. E. Jameson, Esq., Irasburgh.

"Rotation of Crops," by W. S. Thorpe, Esq., Morrisville.

### FRIDAY AFTERNOON.

"Fruit Culture in Northern Vermont," by Dr. T. H. Hoskins, Newport.

### FRIDAY EVENING.

"Farmers' Boys," by J. C. Wilder, Esq., Charlotte.

# CLASSIFICATION

OF THE

# PAPERS PUBLISHED IN THIS REPORT.

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AGRICULTURE.

- FRUIT CULTURE.
- GRASS CULTURE.
- PRACTICAL AGRICULTURE.
- FERTILIZATION.
- EDUCATIONAL.
- GENERAL.

MANUFACTURES.

MINING.

# OBJECT AND AIMS OF THE BOARD.

BY HIS EXCELLENCY GOVERNOR STEWART.

Governor Stewart began by remarking that there are two sides to every subject. It is so in agriculture. There is the mechanical system and the scientific system of agriculture. It is true that China has not only for three thousand years sustained a dense population, but the natural fertility of the soil has continually increased, and this with a system of agriculture which cannot be called, in the technical sense of the word, scientific. It consists of the application to agriculture of those principles which have been discovered by observation and experiment. China produces larger crops than America, without exhaustion of the soil. Our farmers stand in need of better agricultural education. The object of this Board is two-fold. First, to benefit agriculture directly, increase the fertility of the soil, and render returns for labor more remunerative. The second object is to give the people a new sense of the importance and dignity of agriculture; to give them to understand that it is the most dignified pursuit that any man can follow. It involves a knowledge of the principles that underlie all the sciences, and the appropriation and employment of these principles. The object and aim of this Board is the development of every industrial interest in the State. The object is a good one. Its scope embraces not only agriculture, but manufac-

tures and mining. The first is the leading interest of the State, but the others are of great importance. There may be an impression that the Board undertakes to direct and supervise agriculture in the State, but this is an error.

Some may say that the intelligent farmer has no need of such a Board, and in a sense this may be true. But it must be understood that it undertakes not to direct, but to co-operate with the efforts of farmers for self-advancement.

Agriculture is so multifarious, including not alone the tillage of the soil, the raising of crops, but also horticulture, arboriculture, the breeding of animals; so much that is closely allied to science. Indeed no pursuit is in my judgment so scientific as that of agriculture. I know that there exists a very general prejudice against science. But what is science? Only systematized knowledge, systematized truth. No tree or plant but grows in obedience to a law no less fixed than that of gravitation. The facts that we discover in the growth of vegetation, when arranged, lead to the discovery of laws, and these laws, when once known, give a basis for daily work that shall be successful and profitable. In this work, all the natural sciences may and ought to be enlisted.

Intelligent farming embraces all the natural sciences: Botany, Chemistry, &c., all the subtle laws governing vitality and growth. Too many of our young men dislike to work. They prefer anything but honest labor. They go away from among us to seek fields giving greater rewards and demanding less labor. Let us make manual labor, the pursuit of agriculture, more attractive to young men, and they will stay. Show them that every department of knowledge, all the laws of nature lie within their legitimate domain, are indeed at the very foundation of their successful

labor in the field, and you may rest assured that the young men who bring science to aid agricultural work, will not be so easily discouraged or disgusted. They find in connection with their daily labor matters of interest that elevate the actual work above the drudgery which it is when unintelligently pursued. In the meetings of this Board the principal object is to awaken interest and provoke discussion among the farmers themselves. This leads to improvement. The discussion of agricultural facts brings them home to the mind far more forcibly than mere reading.

Discussion will promote reading and reflection. The subject matter will be thoroughly digested and assimilated, thus becoming part of one, as bone and muscle by the digestion and assimilation of food. Agricultural papers therefore are not enough, no matter how good in themselves. Reflective, intelligent discussion is invaluable. The success of the Board depends upon you. Our excellent and worthy Secretary cannot without your co-operation and aid make it successful. He may safely guide, but you must be the motive power. We wish then, to bring men together for discussion, for a comparison of individual experiences; fact by fact, one added to another, and thus at last a science is established. Thus each has the advantage of the widest experience. Let us remember that "everybody knows more than anybody." I have never spoken with any man in any department, from whom I did not learn something. Let us also form habits of close observation, for in this way alone may we accumulate facts and advance our knowledge.

When the farmers are awakened to the importance and usefulness of meetings for mutual improvement, the Board has done a material part of the work for which it was organized. Boards of Agriculture are already in existence in

other states, and unless Vermont means to fall behind, she must take hold of the work. Previous meetings of this Board have been successful in exciting interest where they were held. The people are beginning to see that we *are* falling behind in some branches of agriculture, notably in horses, and they are ready to take hold and endeavor to remedy the evil, and put Vermont where she should be as a New England State, in the front rank of progress. Once started among our farmers, this spirit of progress will not be arrested. When we realize our deficiencies, and with concert of action begin the attempt to remedy them, it will be done. Organization is necessary, in order to proceed in the work effectively. A nucleus for this organized work is found in the Board of Agriculture, whose Secretary, in concert with the members and others, lays out plans and submits them to the people at these meetings for their discussion.

But besides the Agricultural, there are other interests not to be ignored or to suffer neglect at the hands of the Board. It is our aim to secure the development of the copper, marble, slate, and other mineral interests, thus giving employment to thousands of workmen and securing a home market for the produce of the farmer. A full report, then, of our mineral property, its locations, character and probable value, falls within the scope of our field.

Maine recently has had made a complete Hydrographic Survey of her available water powers, their extent and location. The Board have also in contemplation a similar work for Vermont, that in this way capital may be induced to build up manufacturing industries, availing itself of our unsurpassed facilities in water power.

I need scarcely allude to the direct bearing this work, contemplated by the Board, has upon our Agricultural in-

terests. The burden of transportation falls alike upon the producer and consumer. The nearer the market, then, the better.

These three departments, Agriculture, Manufactures and Mining should be developed together. There need be, there should be, no jealousy between them.

The ultimate end of all the business of this Board is to make men and women. The practical results of our efforts will be to educate and refine our people, to introduce them to a broader and finer culture, and lift them directly into a higher plane of existence; to enlarge and elevate their souls. The influence of the Club will lead not only to the making of better butter and cheese; but to the making of better men and women. The Club is worthy the cordial support of the farmers. The Board calls on the farmers for their support in their endeavors to stimulate inquiry and elevate the cause of scientific agriculture in our State. Let it be thoroughly understood that everybody knows more than anybody; that perfect individual development secures perfect social development.

We want to make our State succeed, not only practically, but in that higher sense, in virtue, in intelligence, in culture. We may reap the richest and most satisfactory results from the Board, if the farmers will give it their hearty, earnest support.

We regret that we cannot give, verbatim, the remarks of Governor Stewart, as this brief abstract conveys but a poor idea of their eloquence and impressiveness.

## BRIEF ABSTRACT OF ADDRESS BY PRES. ANGELL.

The President, after responding to the courteous welcome with which the Board had been greeted by the Brandon Club, through its venerable Vice President, proceeded to speak of the existence of Boards of Agriculture in other New England States, and the necessity for such a body in Vermont. A sketch was given of the origin and organization of the Vermont Board of Agriculture. Continuing, President Angell gave an outline of the plan upon which the Board was working. It has aimed to call the farmers together, and to elicit from them original papers to be followed by discussion of the topics treated. At the annual meeting at Montpelier it was intended that distinguished speakers upon industrial subjects from other States should be invited to address the people. Statistical reports in regard to agriculture, mining and manufactures in Vermont are also to be submitted. The object will be thus to promote improvement in all these industries, to develop them, and by disseminating information of a practical character, to make the productions of Vermont not only more abundant but better, and thus more valuable. New York is now making butter that sells for one cent a pound more than the average price in Vermont. Cheese from other localities leads ours at even a greater advance. Vermont can produce these and other things as well as any other State in the Union, and this movement is to aid her industrial workers in doing so. Farther, it was an object to disseminate knowledge of our mineral and manufacturing resources among capitalists elsewhere ; to aid explorers in deciding promptly and without unnecessary expense upon the value of mines, quarries, &c. A hydrographic survey was also contemplated by the Board, by

which the vast water power of our streams might be made known to manufacturers elsewhere. Maine has already made and published such a survey, with most encouraging results.

In agriculture it is also an object to stimulate and report experiments by the enterprising farmers of the State. These experiments once commenced, the interest increases rapidly. By being organized much loss of time and many unnecessary repetitions would be prevented, while results will be widely published. Farmers' Clubs are to be encouraged, and co-operation in all that relates to agricultural interests. Commercial fertilizers, large quantities of which are being offered in our markets, require to be analyzed, and their actual value made known. Considerable work of this kind has already been done by the Secretary of the Board.

All of this can only be done effectively by means of the aid, support, and co-operation of the farmers, manufacturers and miners of the State. With this, the usefulness of the Board will be made sure, and when a report of its work is made to the Legislature of the State, the result will doubtless be a more liberal appropriation to its uses, and its establishment as one of the permanent institutions of Vermont.

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## PRESIDENT BUCKHAM'S ADDRESS.

In the absence of His Excellency the Governor, the Secretary has asked me to say a few words explanatory of the objects of this meeting, and of the designs and aims of the Board. I have consented to do so on the understanding that by relieving the other members of the merely ceremonious duties of the occasion, I shall enable them to reserve them-

selves for the more important work of instruction and discussion.

If I do not mistake the signs of the times, agriculture has entered an era in which it is destined to make more rapid progress than in any previous age. Baron Liebig says that Agriculture, though the oldest of the sciences, and by far the most generally practiced, has made less progress than any other, and this he attributes to the smaller amount of intelligence which has been put into it. But the agriculture of our day is beginning to appreciate the practical value of intelligence, of brain work, of science. The stimulus has come from various quarters—partly from the necessity of competing with the more productive agriculture of the West; partly from the growing scarcity of labor, and the consequent necessity of substituting mind for muscle; but mainly from the increased attention given by studious men to the applied sciences, nearly every one of which has a direct bearing upon agriculture. This progressive spirit manifests itself in the greatly increased patronage of agricultural newspapers, in the multiplication of Farmers' Clubs, in the institution of State Boards of Agriculture, and of Agricultural Schools and Colleges all over the country. Without claiming that very large practical results have, as yet, sprung from these various agencies, it is quite safe to say that the enterprise which prompts and sustains them, is the surest possible guarantee of valuable results in the future. In the case of any industry whatsoever, if you can persuade a few only of the best men in it to bring their whole intelligence to bear upon its improvement, upon the perfection of its processes, the adaptation of natural aud mechanical forces to its uses, and the increase of its profits, the consequence will infallibly be to infuse into the whole body a new spirit of enterprise, which in due time will work out the most un-

expected and gratifying results. To this point agriculture has now come. Never before has it enlisted so much intelligence or prompted so much inquiry and study; never was the aid of science invoked with so much deference and docility; never was there such eagerness to appropriate any knowledge or experience which might contribute to success. And though it must be confessed that only a few of the great mass of farmers in our country have as yet felt this new impulse, still the best men are all thoroughly awake and are putting into the work of improvement such an amount of brains and energy, that the contagion of their example and the eloqnence of their success will ere long bring over the skeptical and the lazy.

This meeting and the series of meetings of which this is the first, ought to do and doubtless will do much towards this end. These meetings will in the first place assist in keeping up and increasing this spirit of agricultural enterprise, which of itself promises so much for the future of this great interest. They will in the second place increase the sum of knowledge, not only of each individual's knowledge, by enabling him to profit by his neighbor's experience and wisdom, but of the aggregate knowledge of all the members. When, for instance, our friend from Irasburgh has given us the best of his wisdom on "Orcharding," and other members have contributed theirs, the result will be that we shall know more about orcharding than he knew, or than all put together knew, before we discussed that topic. That is the advantage of the interchange and combination and counteraction of individual knowledges. And especially when a meeting is favored, as this one is, by the presence of gentlemen who are authorities on almost any subject on which the practical farmer desires information, the opportunity is one of unusual interest and value.

But a still more important benefit of such meetings is the facility they give for reaffirming, sanctioning and promulgating the great principles on which successful farming must be based. If agriculture is in any sense a science, if it has any fundamental principles, it is time that a beginning was made of codifying and disseminating those principles. I have noticed that in agricultural meetings pretty much the same things come up over and over again. It is with them just as it is with our Teachers' Associations. The same grist is ground over and over, or to borrow a Latin proverb, the same mess of cabbage is cooked again and again, and there seems to be nothing new and nothing finished. But agriculture is certainly so far a science that there are in it some principles which have been permanently and unalterably established, and the knowledge of which would be of the highest value to the practical farmer. This Board would do a service which would more than justify its existence, if by and with the advice and concurrence of these representative farmers who are to take part in its meetings, it were to formulate and scatter throughout the State some of the well established facts of the science of agriculture. At the Dairymen's meeting in Rutland last week it was declared to be established by long experience that 72° is the best temperature for curing cheese, an l a cheese maker who was in quest of that fact might well have come from the farthest corner of the State to ascertain it. I know it is not possible to arrive at this precise mathematical knowledge on all the questions which will arise here—that a provisional answer is all that can be now given to many important questions, (and I may say in passing that it is another object of these meetings to commit this provisional knowledge to practical farmers for testing by experience,) but still just this definite and precise knowledge can be given on a great number of

the questions which every enterprising farmer is anxious to ask. And I am sure that this Board could do no greater service to the agricultural interests of the State than to devise some way in which the fundamental maxims of successful agriculture could be brought home to every farmer in the State.

What I have said of agriculture may be said, with some modifications, of the other interests represented in this Board, of Manufactures and Mining. This little State of ours is wonderfully rich in undeveloped resources. We have the raw material for manufactures in great abundance; we have water power unequalled probably on the same extent of territory anywhere in the country; and we have, in the character of our citizens, an amount of potential enterprise and skill, which, if realized, would make Vermont the rival of Massachusetts and Rhode Island in the variety if not in the extent of her manufacturing industry. Here also it is to be hoped that this Board will be able to do some good service by collecting and diffusing information, by suggesting the new expedients which science is constantly finding for overcoming obstacles and utilizing hitherto neglected agents, and by inviting the attention of enterprising men to the unappropriated wealth which is now decaying in our forests, and rolling down our streams, and hidden in our mines. All this it may reasonably hope to do, if it can secure the co-operation of the intelligent friends of industrial progress throughout the State.

## HON. C. H. HEATH'S ADDRESS.

Mr. Heath began by observing that in the course of modern development it has become necessary, in all civilized nations, to organize industrial departments in connection with the government of the country, whose province it should be to investigate and develop the industries of the State. This has become necessary because all rulers have learned that the wealth-producers are the most valuable citizens, and their interests the most important interests of the state. In our general government this necessity has been recognized by the formation of a Department of the Interior, of which the agricultural bureau is a most important branch. All, or nearly all, of our eastern states now have Boards of Agriculture, and in organizing a similar body in Vermont we have, to a certain extent, but followed their plan. The first object of the Board must be to do those things that will tend to increase the population and wealth, as well as the mental and moral improvement of the state, that the commonwealth may rise like a beautiful structure from a sure and solid foundation. For want of that encouragement and those opportunities which it is hoped will result from well applied and united efforts of this sort, many of Vermont's best sons have left her borders and have gone to organize and build up new communities in the west.

The middle-aged and the non-productive portions of our population remain. The consequence is, that we have now been, for more than one generation, bestowing upon other sections of the country the chief results of our energies, and making no progress commensurate with the actual power existing among us to build up a thrifty, prosperous and

growing community. Our own advantages have been overlooked, while an exaggerated idea of the West, inconsistent with the true facts of the case, have drawn from us those very men, who, if retained, would have elevated Vermont to a much higher position than she now holds on the roll of states. As it is, she has scarcely maintained her actual, while she has lost relative position, for to remain stationary in this age of movement is in fact to fall rapidly behind.

When we look about us, we are compelled to admit that we have reached a limit beyond which we may not expect to pass, without making a change in our methods of agriculture, introducing new products, and developing resources hitherto untouched. Not only must the spur be applied to agriculture, but we must push on the development of our quarries and mines, and introduce manufactures of various sorts that may be profitably engaged in, and possibly must have to resort to our water power as a means for changing it. A wise and judicious use of the abundant water power with which we are blessed, would tend to the building up of large cities in our midst, by which the agriculture of that vicinity would be changed from loose grazing to garden farming. Upon such action depends the future growth and prosperity of our state.

Under this conviction the legislature has established this Board of Agriculture, Manufactures and Mines. They have in contemplation an attempt to make a thorough hydrographic survey of the state, and to recommend an appropriation from the legislature for this purpose. They expect, by the collection and publication of statistics, to place before the world the advantages which we possess in this respect, and once known, I think they would be readily improved. Statistics show the abundance of valuable raw material with

us. Its use, and the consequent development of mechanical industry, will essentially modify and improve our agriculture, because manufacturing towns and cities are the best patrons of the farmer.

We expect that the people of the state generally will be aroused aud interested in these matters, and led to organize many manufacturing enterprises among themselves with their own means, thus replacing the domestic manufactures we have lost. In the development of our towns we shall look to see also a great commercial change. Instead of paying tribute to New York and Boston, we may build up centers of population and capital in our own state.

This Board, besides presenting these things before the people by its meetings and its publications, offers a centre about which new ideas and enterprises may crystallize, and thus, by joining together, help to develop our advantages.

We have given but a condensed and very imperfect sketch of Mr. Heath's remarks.

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## ABSTRACT OF ADDRESS BY PROF. COLLIER,

### SECRETARY OF THE BOARD.

Prof. Peter Collier, Secretary of the Board, opened the meeting at St. Johnsbury with a brief statement of the object and intentions of that body, and invoked the support and co-operation of the farmers of the State. He called attention to the fact that the duties of the Board embraced not only the promotion of agriculture, but the introduction of manufactures and the development of mining. The farmer was not a little concerned in these branches of industry, as they increased the consumption of his products and gave him a home

market. Many farms embraced valuable water-privileges, where vast quantities of unused force went to waste for want of the means, knowledge and energy requisite for its improvement. He was anxious to gather statistics on this point, and should make exertions to put on foot at least a preliminary survey of our principal water powers.

The State is also rich in minerals of great value in the arts. The development of this branch of industry has been commenced with success, such as ought to encourage further labor in this direction. The quarrying of marble is already a prominent industry which has built up flourishing towns. Our slate quarries are of the first quality, very accessible to the great markets, and being worked with large profit. Our copper mines also are important, and already add a considerable amount to our resources. In the northern part of the State it is believed that a valuable mineral known as chromic iron exists abundantly, but it has not been developed. Soapstone is quarried and exported to some extent, and our iron mines may not be unprofitable. In all these industries every citizen is interested, for they can be made the foundations of wealth, and all the advantages that flow from it.

There is hardly a farm in the State where hidden wealth may not exist. He urged upon the farmers, when they met with what appeared to them valuable minerals, to send them to him. He would gladly ascertain their nature and probable value by analysis, without charge.

Among other important things now presented to the Board for its disposal is that of commercial fertilizers, which are greatly adulterated. Already the Board has saved the State, in this particular, more than its entire cost for the year. Doubtless they suffered much from frauds in the various commercial articles of this description, which might be pre-

vented, and it would be the object of the Board to protect the public by every suitable means from such frauds. He should say more on this point at another time.

Another point to be considered is the decline of production, either actual or comparative, of our lands. Other countries are increasing their products, and we can, we must do the same. We must do it, and how shall we do it better —how shall we do it at all, unless by first consulting together upon the ways and means. England now raises wheat in large fields at the rate of 50 to 60 bushels to the acre. Vermont averages 17 bushels, yet her soil is better than that of England. England buys our bones—we sell them and neglect our other means of fertilization: that is the reason why she goes ahead and we fall behind.

Prof. Collier called attention to the fact that these early meetings were to a great degree tentative or experimental, and one of their chief objects is to elicit opinions and advice from the farmers themselves as to the best way in which it should work.

But while asking for suggestions from every quarter, he desired to forestall any hostile criticisms from those who desired larger, or more immediate results. The resources placed at the disposal of the Board are trifling compared with the magnitude of the work they have in hand, viz: the advancement of almost every industrial interest of the State. But it is sufficient with which to make a trial, though obviously many desirable things must be left undone, not from lack of knowledge concerning them or of interest in them, but from want of time and means to carry them forward at this time. Also it is to be remembered that the grandest results for which we should strive are those which only are the products of slow growth. The most beneficial

results which ought to flow from the labors of this Board will not be, cannot be, seen within a generation. But there is abundance of work at hand whose results are or will be immediate, to which our attention will be directed, and our wish is that for the present all criticism will be directed towards what we do, rather than what is from necessity left undone.

Finally he spoke of the desire and intention of the Board to aid, without in any way supplanting, all the various agricultural and industrial societies of the State. The State Agricultural Society, the County Societies, the Farmers' Clubs, all had work to do that it would be vain for the Board to undertake, but which it might aid. He hoped one important end might be accomplished in so organizing the work of these various bodies, that their labor might not be wasted, as it often is, by the same questions being gone over repeatedly in each and all of them. If they could work in a systematic way, each might devote itself to the branches most important and best understood in its locality, and by an exchange of knowledge and experience the whole State would receive light.

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I append here an editorial from one of our State papers, which expresses very happily the wants which the Board can supply in some of its more practical results.

"This Board, as our readers are aware, was constituted during the closing hours of the last legislature. It consists of the Governor, President of the Agricultural College and six other gentlemen appointed by his Excellency, and a Secretary chosen by the Board. Its duties in brief are to advance the prosperity of the three industries indicated at the head of this article. It is not to be supposed that the thousands engaged in them are ignorant of the proper methods

of carrying them on, or that this Board will rudely interfere with any methods of working now practiced. It is true, however that in agriculture there are many gems of knowledge scattered in fragments among the successful men in the State in regard to specialties in any branch of industry. For example, stock raising, dairying, the fattening of stock for market, the raising of wheat, corn, potatoes, turnips, beets and other root crops. It may be thought that nothing can be said upon these common topics, but a few years ago the raising of wheat and potatoes in Vermont were doubtful experiments on account of the midge (or weevil) in the one, and rot in the other; and even now but few farmers add to their crops the roots so necessary in advanced farming, not having a proper appreciation of the value of the carrot, parsnip, beet. or turnip as a paying field crop, or as an auxiliary to general prosperity. Then in methods of cultivation, all improvement from the wooden plow of fifty yenrs ago, to the Holbrook swivel of the present day, have been the result of somebody's experiments made public. Many farmers are inventors as well as observers, and it is the aim of the Board in its meetings through the State to consolidate in its papers and discussions those scraps of wisdom and experience that have given success in individual cases, and present them to the farming public through the widely circulated newspaper or in more elaborate reports.

In mining there is doubtless work for thousands of busy hands in future years. Until the subjects had been agitated and investigated, there was no marble quarried at Rutland, no slate at Northfield, no copper at Vershire, or paint or iron at Brandon; and it is safe to infer that further investigation will reveal mineral wealth in other places which in the working will be sources of profit to adjacent communities and to the world at large.

Regarding manufactures the case is somewhat different. It sometimes requires as much sagacity to discern the raw material and facilities of manufacture as to set the business in motion. If anything can be done to cause Vermonters to spend half as much time and money in trying to start new enterprises here, as they do in prospecting in the West, it should be done. We know men, young and old, go singly or in pairs, and in squads, to see other states, and thus are enabled to judge of the chances for good investment. If this Board can induce our citizens to spend some of this time and money in starting new and paying enterprises here, it will repay the State for the appropriation it has made to establish and sustain it. We do not regret, however, the years of toil, travel and itinerant wanderings, that were spent by us in the South and in the distant but ever fruitful and beautiful Oregon. In these journeyings, weary, hungry and footsore as we often were, we yet gained the wanderer's reward in a knowledge of the country and its resources, as well as a higher appreciation of the comforts of a Vermont home. We see work enough for the Board."

# THE DIFFICULTIES OF FRUIT RAISING IN VERMONT.

By Dr. T. H. Hoskins, Editor Vermont Farmer.

This subject is one that opens very widely, but I shall try to treat it with as much brevity as possible.

Vermont is very far from producing all the fruit consumed within her borders, and much further from producing what would be consumed, were it as abundant and cheap as it would become, were the proper degree of attention given to fruit-growing by our farmers.

There is no question with intelligent minds that fruit is more than a luxury; that it is an important element of that variety of food most conducive to health. But even as a luxury its production is important. The country that produces but the bare necessities of life can never be an attractive home; will never attract immigration; cannot retain its native born population, when orchards and vineyards on every side beckon them away. Can we, in Vermont, produce fruit of various kinds with that success and in that abundance that shall satisfy the reasonable demands of her people, and nullify at least one element of temptation luring her sons and daughters away?

I am not long a resident of Vermont, but I think I have lived in it long enough to answer the question I have asked, and to answer it satisfactorily in the affirmative. In four

years, in the coldest and least favorable corner of the State, I have, by the labor of my own hands, on land that never grew aught but grain and potatoes until it came into my possession, so succeeded that my table is amply supplied, summer and winter, with fruit, embracing strawberries, raspberries, blackberries, grapes, currants, and gooseberries, and beginning even to afford apples, cherries, and plums, with a hope of adding the luscious pear as a crowning glory of the feast. Having done so much already, I feel justified in saying that there is no impossibility, no difficulty except the difficulties that add zest to the labors of any man of common earnestness and perseverance, in the way of producing an abundance of all these fruits anywhere in Vermont, with as little labor and expense as is required for the same purpose anywhere in New England. But there are difficulties attendant upon the growing of fruit in our State. That is granted in the very title which I have placed at the head of this paper. To show what are the difficulties I have myself encountered or observed, to show that they are capable of being overcome, and how they may be overcome, is the task I have assumed.

The difficulties of fruit-raising may be divided under four separate heads, viz:

1. Difficulties arising from the severity of our climate.
2. Difficulties incident to soil and location.
3. Difficulties caused by insects and vermin.
4. Difficulties from the ignorance or the indifference of the cultivator himself.

I shall speak briefly of these difficulties in order.

1. *Difficulties arising from the severity of our climate.*

Northern Maine, New Hampshire and Vermont, sloping to the north, and exposed to the full sweep of the currents

of air from the broad snow and ice fields extending to the pole, are subject to excessive cold during the winter months. Being farthest removed from the modifying influence of the ocean, Vermont is especially remarkable for its extreme winter temperature. To what extent this is unfavorable to fruit-growing, as compared with the climatic circumstances of surrounding States, requires consideration. That it excludes entirely the cultivation of the peach, except in a few very favorable localities in the southwestern part of the State, is undoubtedly true. In the northeastern part of the State it also limits the number of varieties of the apple that can be successfully grown, excluding the favorite Baldwin, and still more such sorts as Rhode Island Greening and Roxbury Russet, Newtown Pippin and King of Tompkins County. The blackberry and the foreign raspberries require protection in winter, by laying down and covering with earth or boughs of evergreen. Grapes require the same care; but this is equally true anywhere north of New Jersey, except along the south shore of the great lakes.

After making these deductions, what is our position, and how does it compare with that of our neighbors? To my mind the principal evil consists in the fact that knowledge of fruit growing derived from experience elsewhere, is apt to misguide the Vermont fruit-grower. Our climate, and to some extent our soil, necessitate considerable local experience, considerable experimenting, before we can go to work on any large scale with safety. I think many failures, especially in apple-growing, which is about the only branch of fruit-growing attempted by our farmers to any great extent, may be attributed to a blind following of lessons adapted to other localities, but not to ours. With three-fourths — I hardly believe I should err if I said nine-tenths — of these who undertake the cultivation of fruit in Vermont,

knowledge of the varieties adapted to our necessities is wanting. Indeed, the great majority of farmers know nothing about varieties, or the adaptation of them to localities. With them a fruit tree is a fruit tree; and in the vast majority of cases, if you allow them their choice out of a nursery, they will take the handsomest looking tree and feel sure they have got the best. So far as experience has already given me material for judgment, I am led to the belief that there is no part of our State too inclement to prevent a high degree of success in the cultivation of apples, the staple New England fruit. The same knowledge, patience and skill that make success in other departments of agriculture, will give us equal success in orcharding. While we cannot grow the Baldwin or the Rhode Island Greening with more success than we could grow the dent, or the horse-tooth corn of the south and west, we are not precluded from raising equally good and even better varieties with the same care and certainty as we secure a crop of corn when we plant the kind that we should plant.

The details of pomology do not come properly within the scope of this paper, but I will give a list of apples that embraces the hardier sorts, from which selections can be made adapted to any section of Vermont.

SUMMER APPLES.

Red Astrachan, Peach Apple, American Summer Pearmain, Tetofski, Williams' Favorite.

FALL.

Duchess of Oldenburg, St. Lawrence, Fameuse, Clyde Beauty.

WINTER.

Yellow Belleflower, Tolman's Sweet, Blue Pearmain, Red Canada, Pomme Grisay, Westfield Seek No Farther, Northern Spy, Ben Davis, Ribston Pippins.

These are all well-known varieties, valuble for their market qualities as well as for domestic use. More than as many again might be added to this list equally hardy and valuable, though less widely known.

As regards the small fruits, most of them are perfectly at home in the coldest parts of the State, and can be grown with as much ease and as profitably for use or market as any where else in New England. Still, in them there is a choice of sorts as regards hardiness and adaptation. Take one year with another, I think I am as successful in growing strawberries, raspberries, and even grapes as the horticulturists of Massachusetts. Currants and gooseberries are iron clad as regards climate, but pay as well for care and cultivation as other fruit.

With cherries, in the very coldest places we must be satisfied with the common red; but in many portions of the State the Dukes and Morellos flourish, while in some spots amateurs have reasonable success with the more tender sorts.

In plums we have a stand-by not to be despised in the Red Canada, which thrives every where, and the best of which, (for they differ much), are very good fruit. Several blue and yellow varieties seem to do reasonably well in the colder localities, while many parts of the State are admirably adapted to the plum, and were it not for the curculio could produce them abundantly for the market.

The hardier pears endure the winters of Vermont, and in some places give a very fair return. Fortunately, some of these hardiest varieties are also among the best.

One advantage that we have in Vermont over the country near the coast, is in the depth and persistency of the winter's snow. The amount of protection afforded by this to vegetation is almost incalculable. By taking advantage of favorable locations, where heavy drifts are formed, the for-

eign raspberry and the blackberry may be grown without other protection. Strawberries also may be grown, without covering, more successfully here than in warmer localities where the coldest weather often occurs when the ground is bare. Taking everything together, I see nothing in our climate, when we understand it and adapt ourselves to it, to discourage either orcharding or small fruit-growing.

### 2. *Difficulties of Soil and Location.*

These points, though to understand them is very essential to success, do not call for a long discussion here, for they do not differ from similar difficulties elsewhere. Low spots, where late and early frosts occur, are very ill-suited to fruit. Although the plants and trees may not suffer, they will prove unproductive in such spots. Land that is wet, even if elevated, is unsuited to fruit. Heavy soils must be drained, or fruit trees will not thrive in them. Rich soils produce too rank and succulent growth, resulting in winter-killing even of hardy varieties. The annual growth of branches should not be more (and ought not to be much less) than one foot. Rocky hill-sides are usually well suited for orchards, but some protection by trees or higher hills, from the north-west winds, is very desirable.

### 3. *Difficulties from Insects and Vermin.*

In this respect we suffer less, perhaps, than states south and west of us. Still we have enough to encounter, and the orchardist and gardener must be awake to the danger, and prompt and ready with all the known means of protection. Young apple plantations are liable to be barked by mice and rabbits. The best defense against these is strips of lath tied around the trunks of the trees, from the ground to the lower limbs. These should be sufficient in number to encir-

cle the tree, and be tied with two or three good strings. They are cheap, easily and quickly applied, and as easily removed in the spring. Tarred paper is equally good, but not so cheap or durable. Rubbing the trees with soft soap is also recommended. When a tree has been barked it is not lost, if proper remedies are used. Binding up the gnawed part with a mixture of clay and cow-dung, or earthing up when the damage does not extend too high, will save the trees, if applied before the sun and air has dried the exposed surface. If this has happened, the tree may still be saved by springing in scions, in number according to the size of the tree, and bridging over the barked spot. If carefully done, these scions serve to convey the sap over the break, and as they grow with the tree will in time unite around the trunk and cover the dead parts with new wood. Lice do a good deal of damage to apple-trees. Soap suds, made of soft soap, will destroy them if the trees are syringed with it freely. This refers to the green lice that infest the leaves. The bark louse is also killed by applications of soft soap to the bark in May or June, when the young lice appear, and before they fix themselves and are protected by a shell. Painting the trunk has also been highly recommended as destroying the bark louse without injury to the tree. It may be a safe proceeding, but the soap, well rubbed on, is sufficient, and is otherwise very beneficial to the trees. The virtues of soft soap in the orchard do not stop here. Trees well swabbed with it will never be attacked by the borer; indeed I think no insect or animal will injure a well soaped tree. It needs to be renewed three or four times during the season.

The codling moth, which lays the egg that produces the apple worm, is a great injury to us. The best way to fight him is to tie bands of red woolen cloth around the tree, and

every week or two after the first of August untie these strips, run them through a clothes-wringer, and replace them. The worm after leaving the apple seeks these bands in which to spin its nest for the winter, and the wringer flattens him. If in addition to this all the fallen fruit is picked up promptly, the codling moth will be kept under pretty well. The tent caterpillar is easily managed if you only watch him and destroy his nest when it first appears.

The canker worm is the most destructive of all orchard pests, when he appears in force. Luckily he is only an occasional visitor. He can be fought successfully by any device that will prevent the female, which is wingless, from ascending the trees in spring. Bands covered with tar, pitch, or printer's ink, are used for this purpose, together with various more expensive "tree protectors," in which a trough filled with oil surrounds the tree.

The plum is almost driven out of cultivation by the curculio, or snout beetle. No way of getting rid of him has been discovered, except the troublesome one of jarring the trees every morning, which causes the little turk to drop upon a sheet spread to receive him. Eternal vigilance is the price of plums.

The currant and gooseberry worm is instantly destroyed by dusting the bushes, when wet, with powdered white hellebore. Perhaps the handiest way of applying the hellebore is to mix a heaping table-spoonful of the powder with two gallons of water, and sprinkle it upon the bushes by means of a common watering pot. The carbolate of lime, now extensively used as a cure and preventive for the foot and mouth disease in cattle, is also recommended as destroying the currant worm. I have not tried it, but shall do so, as the hellebore, though effectual, is more expensive.

The raspberry and the strawberry are not much injured by insects, and the same is true of the blackberry. The grape also has, so far as I can learn, no important insect enemies in this State. The large white grub attacks the roots of the strawberry plant when planted in ground recently in grass. Consequently it is best to set a strawberry bed in ground that has been several years in hoed crops. If, however, the grub does attack the plants, I know of no remedy except to dig him out. After having done so, it is optional with you to imitate Uncle Toby, by putting him carefully over the fence with the benediction "go in peace," or to conquer peace in a simpler and more effectual way.

Finally I come to the fourth division of my subject: "Difficulties arising from the ignorance or indifference of the cultivator himself,"—and I confess that I shrink aghast from the attempt to enter upon any statement of these difficulties in detail. I never knew a man of ordinary intelligence and perseverance, who loved fruit growing, and failed of reasonable success in the pursuit. Now the inference from this is plain, that want of success in fruit growing is not due, with us, to any or all of the preceding "difficulties." Its cause must be sought for in the last.

On the point of ignorance or imperfect knowledge, let me say that there is no difficulty in the whole business, from beginning to end, that any man, capable of success in growing the ordinary crops and breeding the common animals of the farm, cannot easily surmount. Of course each man has his peculiar tastes, and is naturally drawn by them. But a man can, if he thinks it desirable, though he have no taste for it, become a successful fruit grower. He would not find it so easy and pleasant as the man who loves it does, and I would not advise such a man to make it his principal business. But there is no reason why he should not give it sufficient

attention to provide fruit in abundance for family use. I have no taste for horses, but I can care for as many horses as I require for my work as well as any one. So the man who is fond of horses or stock can, in the same way, give the needful attention to an orchard or a fruit garden. All that is wanted is the will to do it.

To such a man I should say, buy a good book on the subject, such as Barry's Fruit Garden, or Thomas' Fruit Culturist, and study it. Let him visit successful fruit growers and talk with them on the subject, and get their advice, especially upon the points of location, planting and training. Let him be willing to give one or two hours a week to his orchard. That will be enough if he has no more than fifty trees. Occasionally he may have to give a half a day at certain seasons, when winds, or insects, or mice have given him a job. But in all these things an ounce of prevention is worth a pound of cure.

I think a love of fruit trees, like a love of animals, will grow upon any right-minded man as he watches over and works among them. The work grows easier, too, with experience, and more pleasant when results begin to show themselves in the tangible form of rich products. However little interest one may take in the trees and plants, the fruit itself is acceptable to most every palate.

Nine-tenths of all the fruit trees set out in this country fail ever to produce fruit enough to pay the first cost of the trees. This is the average of all. Yet ten per cent. will probably cover the loss of the man who will give them reasonable care. What a waste!

It is true that somewhat the same may be said of all farm products, but though there is great and unnecessary loss incurred in these, they are not so great as those of tree planting. The reason is that all farmers are trained to some

knowledge, in their youth, of the ordinary work of the farm, but few are ever taught how to plant and care for fruit. And there is a feeling that the art of fruit growing is too difficult to be easily learned. Many, too, have not the patience to wait and care for young trees until they come to bearing age.

Now I do not hesitate to say that there is more science in raising pigs than in raising apples, and five times the work for the amount of profit realized. When you come to compare an orchard with a colt, the difference is still greater. An orchard will begin to bear fruit in the same time that a colt is reaching maturity. At that time the orchard of fifty trees has not cost half the money, nor consumed one-tenth of the time and care bestowed upon the colt. As to the comparative value of a thrifty six year old colt and a thrifty six year old orchard of fifty trees, of course there will be a great variation, but the preponderance will in most cases be greatly in favor of the orchard. I am not opposed to rearing colts, but I want to see orchards planted also.

Mr. J. P. Foster, (Passumpsic,) said he had had a long experience in orcharding, with a fair degree of success. He was convinced that in this business a living dog was better than a dead lion—that a fruit tree not of the highest excellence, that would live and bear well, was better than a variety that would not thrive, however excellent its fruit. But few of the favorite apples growing south could be successfully planted in this section. He had many grafted trees that had done well, but he got the best results with natural fruit. Many seedlings were tender and perished, it was true, but those that survived were much more healthy and productive than the average trees. He had set quite a large orchard upon a hillside, too steep and rough for cultivation.

This orchard was composed of both natural and grafted fruit, and was doing well. But we are near the northern boundary of the apple, and cannot succeed without giving our trees good care. He spoke highly of the Shaker Greening, as very hardy, of good quality, and productive. He thought we might hope much from the Russian apples. He was planting the Duchess of Oldenburg, and should try the Tetofsky.

Several other gentlemen, whose names the reporter did not learn, spoke briefly, and some of them not very encouragingly, of their success in fruit growing. But the general tone was one of desire for success, and a determination to persevere.

# FRUIT-GROWING IN THE CHAMPLAIN VALLEY.

A PAPER READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, AT MIDDLEBURY,

BY C. G. PRINGLE, ESQ., OF CHARLOTTE.

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The generation that in its childhood played under the old apple trees, which stood sturdy and hale upon our hillsides, or from wide spreading branches showered their luscious bounties, ruddy and golden, about the door-stones of our old homesteads, are now in middle life, and those primitive orchards falling in swift decay. As we find that we must replant our orchards if we would continue to grow fruit, scarce one in ten is to be found among the farmers of our valley who is not planting trees, or who, stimulated by the example of his neighbors, does not intend to do so as soon as he is able.

But he who starts anew to-day in the enterprise of Fruit Culture, meets at every step of his progress difficulties which he did not anticipate, and encounters failures which will drive him from the field, (or at the very least, rob him of the high profits upon which he had confidently reckoned,) unless he faces them with energy and overcomes them by intelligent skill. In his perplexity he finds the experience of his father has left him few rules for guidance. They set,

with but little care, in a soil light and rich from forest mold, a hardy stock of natural fruit. Their orchards were shielded from harmful winds by the abundant forests then still standing. The numerous insects, which now work mischief with both tree and fruit, were then almost unknown. Consequently, whether they cultivated their orchards in hoed crops or cereals, or even left the soil in mowing or pasturage, it was much the same: they looked at harvest time to see their trees loaded down with fruit. They gathered a store that had cost them little care or labor.

But now the conditions affecting Fruit Culture are greatly changed. The vegetable matter, then so abundant in the soil, is now exhausted, and the latter has become compact and stubborn. The humidity, so favorable to vegetable life, which then prevailed in the soil and in the atmosphere, has given place to long summer droughts, whose severity often forbids the full development of our crops. The thin and scattering wood lands no longer restrain the fury of the winds, which intensify upon the exposed trees the severity of winter's frosts, that play rudely with the blossoms of spring time, interfering with the fruitful offices of stamen and pistil, and which shake from the bending trees in autumn half their load of fruit before it is fully matured. And with respect to our insect enemies, so destructive has the borer become, that, unless followed up with untiring patience, it endangers, in most places, the life of the whole orchard. And besides the borer, from the time the curculio sets his mark of proprietorship upon the young fruit, when it is no larger than a sparrow's egg, until it is ready for gathering in the fall, there arrive in the tree, to prey upon its leaf or twig or fruit, a constant succession of reinforcements—now an old foe to be fought with well approved weapons, and

again a new one, whose habits must be studied, and whose weakest point discovered.

I am induced to venture a few suggestions, drawn from the experience of the best cultivators of the present day, which, it is believed, will obviate in a good measure these embarrassments that face the new orchardist, and will point out some of the best methods of culture. I wish, also, to propose a few special aims for Fruit Culture in this Champlain Valley, whereby the highest returns may be secured.

The fruit interest of our valley bids fair to rival in importance even the dairy interest, now so prominent. The large area already devoted to orchards, (especially in the immediate vicinity of the lake,) and the large returns made by those which have now come into bearing, suggest a prosperous future for our farmers.

Though situated on the northern limits of "bleak New England," the valley of Lake Champlain lies low and warm within its mountain walls. Secluded from the cold winds of the north-eastern coast, and open on the south, through the valley of the Hudson, to the genial influences of the Gulf Stream, it enjoys through the four summer months a climate but little inferior, in its adaptation to fruit growing, to that of Central New York. True, its area is limited, and in winter, after the lake closes over, it can not escape the rigorous frosts that belong to its latitude; yet the hardier fruits may be grown here in such amount and of such peculiar excellence as to insure the valley a fair fame among the fruit growing regions of the Union.

Fruit growing, as a speciality in our husbandry, commends itself to the attention of our agriculturist, at the present time, in an especial manner. The cheap productions of the fat soils of the great West, and the comparative exhaustion

of our own lands, compel a complete remodeling of our agricultural system. Many crops we can no longer afford to grow, while there are certain specialities, lying within the scope of intensive farming, which can most profitably engage our attention.

Fruit growing is one of these, requiring considerable labor and yielding large returns in comparison with the area of land and the amount of manure employed. And fruit growing possesses the further advantage, that it may be carried on harmoniously in connection with dairy farming, or the rearing of blooded stock.

But the inquiry may be raised, is not our fruit interest, also, in danger from western competition? And the question would seem to be answered affirmatively by the fact that Michigan apples only last fall were brought into our State and sold at prices which caused our growers and dealers heavy losses. But another significant fact remains to be told. Those same Michigan apples in this month of January are melting down in a mass of rot, while our home grown fruit, matured through our cooler autumn, opens nearly as fair and sound as when put up. This fact gives our fruit an advantage which places it above all peril from any competition; and assures us not merely of first rate profits, but of *exceptional* profits. How shall we turn to account this advantage? How shall we give to the fruit of the Champlain Valley the peculiar reputation and extraordinary value which it may hold for home market and for shipping purposes?

In the first place that concert of action is necessary, which is prompted by the community of our interests; only those varieties should be planted for market which possess good keeping qualities. Our fruit should be grown with the care

and skill requisite to insure its fullest development, not only of external appearance, but also of intrinsic quality. It should be picked, sorted, and put up in neat and uniform packages, with every care. No. 2 fruit, including slightly bruised specimens and such as have been hastened to maturity by worms, will serve for home consumption in the early part of the season, or may be sent to market for such price as it will bring. But strictly No. 1 fruit, unless sent to the seaside for shipping to foreign ports, should be withheld from market till the glut, occasioned by western receipts, is over. It may be stored in cellars fitted for this use, or better, in fruit houses constructed for the purpose. In this way it may be kept till the spring months, when it will bring two-fold the price that ruled in the fall markets. This plan is not an impracticable one. It promises to build up for a large body of our valley farmers a most lucrative business. It is mainly that I may propose this definite aim for our fruit growing, that I present this paper. Whatever else I may say is quite incidental.

To promote this concert of action among our orchardists, and to gather and disseminate the information essential for attaining the fullest success in this culture, a Fruit Grower's Society is imperatively needed. Such an association is struggling into existence in the Champlain Valley Horticultural Society. It gives me pleasure to improve this opportunity to suggest its claims upon the orchardists of this region. And I would bespeak for an organization which has for its object the development of this important interest, as well as the encouragement of a cultivated taste in the nicer department of gardening and floriculture, the earnest support of every one in the valley who is engaged in these pursuits.

But our fruit growing is not restricted to the cultivation of late keeping kinds, by considerations of pecuniary ad-

vantage. Other worthy aims, and promising in comfort, as well as return of money, suggest themselves. There is quite a demand in our towns for summer fruit, and at paying prices. It will increase with the growth of our manufacturing interests, and the increase of our urban population. The demand is mainly for apples; but it also relates to pears, plums and cherries, and to the small fruits, strawberries, raspberries, currants, &c., the culture of which, as special crops in this vicinity, is much behind the times. Caution is needed in planting these summer fruits, lest the local markets should be overstocked, for the perishable nature of the fruits will not always allow of the surplus being sent to distant markets with safety.

But there is another aim of our fruit growing, which is of the first importance. It should not be lost sight of by any cultivator; and even those unfavorably situated for engaging largely in this business, may worthily occupy all their efforts in this field. This is the raising of a constant supply of wholesome fruits for one's own family. In planting for this object, besides all the small fruits, and plums and cherries, a different selection of apples and pears is recommended from that for market purposes. Of these, varieties may be selected of such excellence as to give fuller satisfaction than can be afforded by most of those hardier and more productive sorts, found most profitable for market. A list of such apples may be made out as will circle the whole year; and pears will come but little short of doing this.

Our fathers made a wise selection of their orchard sites, when they occupied our well drained ridges and hill slopes. Usually this remains our best fruit land; and if the old trees have disappeared, even to their stumps, so as to admit of a thorough preparation of the soil, or, if the owner is willing to grub out by the roots the few remaining trees, (and this

is no very laborious task, when two men can cut around the roots of ten or a dozen in a day, so that a team, hitched to the tops, can readily pull them over,) these lands may still be devoted to fruit. Besides the usual preparation of the soil, which I shall presently describe, a liberal application of wood ashes is all they need in most cases, to enable them to start another orchard into good growth. But since all our soils are dryer than they were sixty years ago, in case of need, much lower lands may be used than then. They may in general require thorough drainage to cut off all springs, and to carry away the rain fall of spring time and late autumn, as well as to render them warmer, and improve their condition by exposing them to the influence of the atmosphere. The question of

EXPOSURE

demands notice. Except for the purpose of hastening the ripening of early summer fruits, a very sunny exposure, particularly if of a very dry and warm soil, is not to be preferred to a northern one, provided the latter does not possess a cold and springy soil. The fruit grown on the latter will show the better keeping qualities, and the trees will suffer least from severe droughts. In this valley, in the neighborhood of the lake, I have never heard much complaint of spring frosts, which in some fruit regions imperil the blossoms. Whenever these may be imminent, a western exposure is better than an eastern one exposing the trees to the warm rays of the morning sun. It is principally the mischief of late spring frosts that makes an elevated situation preferable to one on low lands, when distant from large bodies of water.

WIND BREAKS

are a growing necessity in our Horticulture. As the face of the country is denuded of forests, the winds descend in

force to the surface of the ground, clearing it of its beneficent covering in winter, accelerating evaporation in summer time. The trees bend before its force, and acquire a permanent stoop. A great portion of their fruit is stripped off before it acquires any value. To obviate these disasters, a liberal planting of evergreens is advised, at least on the side of the prevailing winds of summer and autumn, (here the south and southwest,) and at a little distance from the fruit trees, so as not to overshadow or rob them of their food. If the orchard is of considerable extent, belts of evergreens, at a distance of twenty or thirty rods are needed; and in very exposed situations, it has been suggested to insert frequently an evergreen in place of a fruit tree. The *arbor vitæ* is very useful for this purpose; and so, for higher and more rapidly growing screens, is the Norway spruce. The latter should be chosen for the outer belts, and the former for the interior ones. The two most valuable orchards in this valley, at the present time, are situated about a mile from the lake, and some 200 feet above it, on a soil naturally well-drained and warm, and are shielded from strong winds by a range of wooded hills. Here the Baldwin, in many places in the valley found tender, flourishes in perfection. A too close proximity of orchards to wood land is to be avoided. These do not allow the free access of light and air, and send their roots into a cultivated field for a long distance.

Whether the planter employs an old orchard site or selects a new one,

THE MOST THOROUGH PREPARATION OF THE SOIL

he can make will be found the very cheapest plan he can pursue in the end. When perfect drainage is secured, the most important part of this preparation is deep working of

the soil. By long periods of cropping, the vegetable matter in the soil has become greatly diminished. As a result the surface soil is made heavier and tougher. The mechanical operations carried on above have beaten down the subsoil, sometimes forming a hard-pan almost impenetrable to the roots of plants, and impervious to the air, which seals over the stores of mineral wealth reserved for the use of plants below. Deep plowing and subsoiling, by loosening up this hard sub-stratum and permitting the air to circulate deep, by bringing up to be weathered on the surface and made available for plant food, these fresh supplies of mineral matters, by carrying down and mingling with the lower soil the well weathered surface, and by incorporating with the whole the coat of manure applied to the surface at the start, secures just such condition of the soil as will enable fruit trees to make a vigorous growth while young, and to yield good crops when older, enduring the summer droughts and winter frosts. There are certain sandy soils and deposits of light drift and alluvium, that may not require such deep working; but such soils are exceptional here. Our best fruit lands are strong, gravelly loams, clay loams and slaty soils.

When the whole field has been thus worked to the depth of twelve, fifteen or even eighteen inches, (as may be done by the double Michigan, the Holbrook sod and subsoil, or the Iowa deep-working plows,) there is no need of digging large holes to receive the trees. A hole large enough to admit all the roots without bending is sufficient. I would insist upon a mulch of a bushel of cow or hog manure, spread about the tree just beneath the surface. The covering of an inch or two of soil keeps it in place, and assists it to retain its moisture during dry weather. With this mulch the tree may make shoots of twelve or eighteen inches the first season; without it, it will barely survive.

As important as mulching is

CULTIVATION,

frequent stirring of the soil the first year and every year. Plow your orchards; not deep, but shallower each year as the roots fill the soil. Let not the advocates of grass and weed cultivation in orchards ( a method which succeeds in the west, where there is an object in reducing somewhat an over-rich soil,) lead you to remit cultivation here. Plow twice a year; in the fall turn the furrows against the trees, and in the spring back-furrow and turn them away. By means of short whiffle-trees the plow may be run within two feet of the tree at first. Leave the narrow strip on which the row of trees stand, unoccupied by crops, and keep it light and clear of weeds by means of the horse hoe.

Most farmers will insist on

CROPPING

their young orchards. If they only put on hoed crops,—corn, potatoes, beans and roots,—and manure freely, they will succeed quite well with their orchard. But if they undertake to grow grain they will hardly do so.

But after the orchard comes into bearing, undoubtedly the most profitable course is to allow the trees full possession of the soil. A crop which half succeeds in the shade of an orchard must be a very valuable one to compensate for the loss the fruit crop suffers therefrom. With a Share's harrow or a Carhart cultivator, let the soil be stirred to the depth of a few inches several times during the summer, adding a dress of manure after each heavy crop. Mulching promotes the keeping quality of fruit, and no mulch is better, perhaps, than a well stirred surface.

Not only do

damage the fruit in amount and character, but they injure the keeping quality. They may be held in check by no means more efficient than a few swine. Allowed the range of the orchard, they make pork by fall with little extra care or cost, — the crop of a few trees of sweet fall apples and a little corn at the end of the season.

The right time for gathering fruit to ensure its keeping requires attention. It is well known by observing horticulturists, that winter fruit may become over-ripe, while yet hanging on the tree, so that its season is advanced. Such was the case during the very warm and late fall of 1870; and the following winter there was a complaint all through the country that fruit could not be kept. In some places it was gone before New Year. There is a time in the life of a fruit when its growth is complete, — when it will receive nothing further from the tree. It is then tree-ripe. Shortly after begins after-ripening, a chemical change, whereby the starch, abundant in the unripe or green fruit, is transformed into sugar. At the completion of this saccharine change the fruit is in the best condition for use. But almost immediately putrefaction sets in, first dissipating the volatile aroma and destroying the delicate flavor, and finally converting the grateful sugar into an unwholesome acid and consuming the very tissues of the fruit. Though a low temperature and dry atmosphere may sometimes retard this change, yet so easy and rapid is its progress, that efforts to preserve the fruit after it has become ripe for use are of little avail. But the progress of the first change, the after-ripening, may be so delayed as to require several months for its accomplishment. It is done by taking the fruit from the tree at the moment of its maturity, and keeping it in a low, even temperature, in a dry, pure atmosphere and secluded from the

light. Fruit houses are constructed where these conditions are secured almost in perfection; where the thermometer, for instance, does not rise above 34° for months together, and fruit kept in them has barely ripened for the late spring market. Similar houses are needed in this valley, yet the conditions they supply may be obtained, in a good measure, in a good cellar. And as to the over-ripening of fruit on the trees, it is not often we, in this latitude, suffer damage from this cause. We stand in more danger from injury by freezing.

I will only allude to the subject of

PRUNING,

fully treated of in books, to say that, owing to our severe winters, the best time to prune is after the cold weather of winter is over, and before the buds commence to swell. Let the amount be moderate—only enough to give an open, symmetrical head while young, and to keep the interior clear of useless, slender growths, and to allow each branch a full share of light and air when older.

It is very desirable that the product of our orchards should be as uniform in amount year by year as possible. Especially would this be important, should we be at pains to make preparations for keeping it. As the case stands, we are burdened and our trees exhausted by excessive crops in some years, and in others we experience a dearth of fruit. The bearing of orchards is more under the control of the orchardist than may generally be supposed. Despite the influence of favorable or unfavorable seasons, the removal of the young fruit from a part of the orchard will be very likely to cause that part to bear the next year, while the other part rests; and this alternation will be apt to continue. Other means more or less efficient might be suggested.

I cannot undertake, within the limits of this paper, to enter into the details of fruit culture, and the abundance of our fruit books renders it unnecessary. I merely offer these hints, suggested by the peculiarities of our climate and agriculture.

I will close with lists of selected fruits adapted to the various purposes that have been suggested. For general market use the Baldwin stands prominent by reason of its productiveness and fair appearance. In unfavorable soils and exposure, and at a distance from the lake, it is tender and short-lived, but here it will often succeed if grafted in the head of a hardy stock. Next in value, and even more popular because more hardy, is the Greening. The King of Tompkins County, and the Northern Spy, the latter very hardy, though tardy in fruiting, are good keepers, and are freely planted. So of the Russets, Roxbury, Golden, and English, of which the Golden is most sought for, though the English is one of our very longest keepers.

For a succession of choice apples for a family supply through every month of the year, the following may be named:

SUMMER.

Early Harvest,
Red Astrachan, and
Benoni, (both very hardy,)
Sweet Bough,
Summer Rose,
Early Joe,
Primate, and
Golden Sweeting for table, and
Keswick Codlin, and
Summer Pippin, for cooking.

AUTUMN.

Hawley,
Lowell,
Porter,
Jersey Sweeting, and
Munson Sweet, for dessert, and
Gravenstein, and
Lyman Pumpkin Sweet, for cooking.

| WINTER. | SUMMER AND FALL MARKET. |
|---|---|
| Hubbardston Nonesuch, | Red Astrachan, |
| Peck's Pleasant, | Keswick Codlin, |
| Yellow Bellefleur, | Summer Pippin, |
| Melon, | Fameuse, |
| Belmont, | Gravenstein, |
| Swaar, and | Colvert, and |
| Ladies' Sweeting for dessert, and | Lyman's Pumpkin Sweet. |
| Tolman Sweet, for cooking. | |

MARKET PEARS.—Clapp's Favorite, Bartlett, Flemish Beauty, Howell, Buffum, Seckel, Louise Bonne d' Jersey, Beurre d'Anjou.

A succession for home use might be secured by the above list, adding a few good winter sorts, as Josephine de Malines, Duchess de Bordeaux, Mt. Vernon, and Easter Beurre. The new winter pears just named, it is hoped, will serve as late keepers for market.

Among plums the Lombard proves hardiest and most prolific, but under good care many others give good results.

Our hardiest cherries are the Dukes and Morellos, the best of which are the Common Pie, or Late Kentish, the Late Duke, and the Early Richmond. The Heart and Rigarreau cherries in warm gardens may survive some time and bear moderately.

# ORCHARDING.

A PAPER READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, AT MONTPELIER, FEB. 21, 1872,

BY E. E. ANDREWS, ESQ., OF BERLIN.

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While it is a fact that nearly all men are lovers of good fruit, yet it is shockingly strange that so few among those claiming to be scientific farmers ever turn their attention in this direction, or ever take any interest in its growth or cultivation; and it is not less strange that those who claim to be skilled in the art of fruit culture have made such great mistakes, and displayed so poor a taste in the cultivation of the same. It is quite laughable, (and yet, one ought to feel more like weeping,) to pass by or go among orchards that are common with us at the present day; as one beholds the work of half a century in the formation of a massive pile of brush, dead limbs and scrags, whose fruit, (if any,) corresponds well with the general appearance of the tree.

I would set reason at work and say, that if the cultivation of fruit can be made to pay at all, it can, like all other products of the farm, be made to pay best by thorough cultivation and a vigilant, watchful care from its germination to its maturity, and even to old age. Whoever thought to plant an acre of corn on poor, worn out soil, to see how many bushels he might obtain, without first feeding the soil with some good practical fertilizer, for which its bowels per-

haps had yearned for years, or without thoroughly working the soil from the time of planting until the harvesting thereof; keeping under subjection all foul trash that is common to the earth, and without which corn, like other cultivated matter, must inevitably fail of success? Or what man ever thought to see how great a man he could make of his son of two years, without first implanting noble principles in his young heart, and making holy impressions upon his tender mind, rather than neglect him until he is nineteen or twenty years of age, and then cut and slash and hew and fashion until he had nearly spoiled the child, before he had fashioned him into shape where he would pass for human? The latter process is about the style of fruit management by many of our farmers at the present day, neglecting the cultivation, the pruning, and the fashioning of the tree until its whole top has become so obstructed by the massive swamp of limbs and brush already referred to, that a man almost hazards his life to enter it for his fruit. And only for the fact that in harvesting what little fruit grows on such trees, they have been obliged to leave some part of their shirt among the branches as a memorial, and are lucky to escape even with a scratched skin, would they be led to prune at all; but having become slightly sensitive from the harsh treatment they have received, and feeling themselves poorly paid for their labor, they are prompted to take their axe in hand, and straightway commence amputation, taking everything clean, dead or alive, until, on a clear day, they can see the sun through on the other side, and say to themselves that a notable deed has been done this day none can deny, and go their way apparently satisfied that science is quite a chap after all. The future prospect of a tree thus mutilated may be better imagined than expressed. If it lives, God be praised, and not the man that sought vengeance thereon.

There is another style of cultivation which might appear to some men to be performed on scientific principles, (but to me it would seem otherwise,) where men are as choice of a little scrub apple tree that springs up in their field as they would be were it classed among the most favorite varieties of the day, and are so fearful that it may be injured by plow or team that they fairly cringe as the team passes, with now and then, "take care, boys, don't hit that tree," which at the same time, being without enclosure, and exposed to cattle that are ever accustomed to roam the fields in spring, has been gnawed and pruned and scrubbed by them for years, until it has become, not exactly a thorn in the flesh, but a thorn in the soil, (what some would call, perhaps, heading in.) I venture to say I can show you trees, (if you may call them by this title,) in our own neighborhood of like character, that for twenty years have not borne the value of a peck of apples, and those, if any, showing signs of a very hard year.

No wonder we so often hear complaint from such men, that farming is pretty hard business, and does not pay. Who ever knew farming to pay any man who did not attend to it otherwise than to let nature take its course, and allow the tares and wheat and filth of the earth to grow together?

But, gentlemen, we have a plenty of this class of farmers all around us, who do not allow themselves to be troubled with trifling notions of farming or fruit growing; and yet, many of them seem somehow to live about as long as anybody, and occasionally one dies as he has lived, *quite easy*.

I possess no secrets in the art of fruit raising, which ought not to be familiar to all. But while it is a part of our nature to differ from each other on nearly all topics, I shall be allowed perhaps to differ somewhat on some points from some of my brother farmers in regard to the *modus op-*

*erandi* of fruit culture. As the old native fruit of our country is about playing out, as the saying is, our farmers are beginning to think that necessity demands an effort in this direction; and for the last fifteen years experiment after experiment has been tried, and in many instances has failed of success. This is not attributable, however, to any one particular cause. Trees have been brought from various parts of the country, and have undergone nearly all kinds of treatment, from that which is passably good to that which is utterly bad; and either the tree or the nurseryman or his agent stands condemned in the mind of him who has made the trial. Now while there may be just cause for complaint, which I doubt not there is, yet while the nurserymen may be strictly conscientious in the sale of his trees, the change of climate and the change of soil may be such as to render the cultivation thereof unsuccessful. I would not be understood, however, to say, (or much less to think,) that all fruit dealers are honest, (though there are some honest, no doubt,) for the experience of many of our farmers has proved it quite the reverse. And it becomes self-evident that the man who will sell you an inferior article for the choicest and best, who has no regard for his word, but looks only at the dollar, will choose his agents from among those on a level with himself.

Tree peddlers are becoming, like pusley, quite common, and everywhere present. My experience with them has been somewhat limited. Occasionally, to add a little to my variety, I buy a few trees. Some six or seven years ago I bought a small number of trees, to be delivered at Montpelier. On receiving my notice I immediately called for them, and finding the proprietor and his agent both present, my attention was very soon directed to a small bundle bearing my name. I examined it carefully, and said to the proprie-

tor, "These trees are dead." "Oh no," said he, (with a good deal of self-complacency,) "they are all right. All you have to do is to dig a hole in the ground and bury them completely for three days, and they will come out all right." Well, I knew that Jonah was three days and three nights in the whale's belly, and he came out all right, and I knew that man must die and be buried, in order to rise again; but whether he founded his theory on Scripture illustrations I could not tell; but, like many men now-a-days, my faith was very small. I finally told him I would pay for the trees, (the price being but $7.00,) but if he would sell me another lot just like them for seven cents I would not take them.

It fell to my fortune, twenty-five years ago this spring, to leave my native town and take up my residence in Massachusetts, where I resided eleven years. During that time, though I had but little experience in the line of fruit, yet my close observation of the manner and style of the fruit culture proved no disadvantage to me, as it naturally would to no man interested therein. The striking contrast between that part of Massachusetts where I was, and of our country, in regard to the culture of fruit, was peculiarly noticeable; and one going from this place to that above mentioned would at once have his attention arrested by the general healthy and vigorous appearance and smoothness of bark of the young trees. Can fruit be successfully raised and made to pay in Vermont, as in her sister States? I cannot answer as to all parts of our State, but from what little experience I have had I think I can answer as to our own county, and know not why it may not apply throughout the State.

Fourteen years ago I returned from Massachusetts to where I now reside, on the old homestead farm in Berlin. The old orchard on this farm, which is now from 70 to 75 years of age, was said to be, years ago, one of the best or-

chards in our country; but when I came back, I found it failing rapidly, and the general inference was that in a few years more the orchard that used to bear us over 1000 bushels of apples a year would afford us but a small part of that amount. The succeeding fall I planted a nursery from seed taken from our native fruit, and thinking the first step to be taken was the most important one to warrant success, I thought to prepare my ground for the reception of trees that I intended to graft in due time, which I did do on the first of May, 1861. At the time of planting the nursery I selected a plat of ground, of good soil, easily to be enclosed, which I thoroughly did with a stone wall. I then manured heavily and plowed the ground deep. I thought it necessary to thoroughly stir the soil to a proper depth, that the roots of my trees might have no reason to complain of the quality or the amount of food as a prerequisite to a rapid and thrifty growth. I planted potatoes on said ground for two successive seasons, for the purpose of thoroughly pulverizing and subduing the soil previous to setting trees. In the year 1863, my trees having two years growth from grafting, I transplanted them into the plat of ground referred to, but in doing this I made one mistake. I set them but 16 feet apart, thinking perhaps one-half of them would die in a few years, and not knowing positively but they might be systematic in dying, as well as in living, and thus every other tree for my benefit would die, leaving the remaining ones 32 feet apart. But in this, as in many things that are common to life, I have been very much disappointed, (not unhappily so, however,) for, out of the 106 trees on the ground referred to, only 6 or 7 are now dead.

When my trees were grafted they were all grafted in the root, a way I would highly recommend. In transplanting,

my plan was to set deep enough so that the lower part of the scion, say as much as was covered with the waxed cloth, should be beneath the surface of the soil, thus causing roots and fibers to grow out from the scion itself, giving a more snbstantial support to the growing tree, as well as a stronger warrant to its future success. When I transplanted my trees my plan was to cut or shorten the main top of the tree to a proper height, for two reasons: 1st, that I might fashion my tree to my own fancy and liking; and 2d, that I might not overtax the root of the tree, as you are all aware that by transplanting you very much retard its growth the first year. I was particularly careful in the outset to cut very smoothly every thorn or objectional branch from the tree, and in three years time all such as are made by smoothly and carefully pruning are unnoticeable.

I kept my ground cultivated for several years, until it became quite difficult to work the soil longer on account of branches interfering. Then I stocked the ground, but continued to keep the soil loose by use of the hoe around each tree, and the grass and weeds subdued on a circle of about three or four feet in diameter. Since seeding my ground I have made no application of manures except leached ashes, which in my opinion is one of the best fertilizers that can be applied to young trees, though not to dispense with other kinds by any means. But let me caution all who are interested not to imitate the example of many that have come under your observation, by heaping ashes or manure of any kind around the trunk of your trees. Common sense will teach all that are teachable that the roots of trees will extend over as much or more surface as the top, and also that the young fibers are the recipients of nourishment, and that those fibers are always found in abundance at the extremity of the roots, while very few are found near the trunk of the

tree. I would advise you to spread your manures, and a plenty of them, broadcast over a surface as large or even larger than you think the roots have already extended, and, when your trees have reached the age of six or eight years from graft, if you plow at all, plow shallow, that the young and thrifty roots be not disturbed.

From the time of setting my nursery until now, I have taken the utmost pains to remove every young shoot that starts where it is not needed, being careful to keep the center of the tree open; there is great objection to a tree becoming full-topped in the center. The best time to remove young shoots is when they first make their appearance, by rubbing them off with thumb and finger, which is very easily done, if not neglected too long; and if so, cut smoothly with a sharp knife, that there be no scar to tell of you in future years. Every man that has a nursery should make it a point every time he passes through his nursery, which should be often, to be on the lookout for these young intruders, and give them a hearty pinch or a hard rub. It has been my custom to wash my trees every spring very thoroughly with strong soap-suds, adding two quarts of water to one of soap, and with the exceptien of two years, I have kept up this practice, taking a coarse cloth—the coarser the better—and rubbing the bark of the tree from the roots to the branches, and as far into the branches as can be conveniently done, drawing the cloth back and forth between the limbs where they join on the body of the tree, and in others above if necessary, bearing on as hard as conveniently may be, until not a particle of rough bark or scurf remains, thus leaving the bark of the tree in a most vigorous and most healthy appearance, looking as though you had given it a coat of varnish. Reason teaches us that it is as much for the health of the tree to be kept clean and free from scurf,

as for a lousy man to go through a similar process of soapsuds renovation. In following out the above named process the cause of so many pests, prevalent in many localities, is somewhat removed. With man I am not allowed by right to retaliate; but with insects I claim a right, when they come to destroy my trees, to put them as an enemy under my foot, and if the pressure be greater than they can bear, they must die. I vindicate my right by removing everything of the kind from my trees, a task not very difficult, if commenced in season, and continue to be thorough, except it be with the canker worm, the worst of all pests to which a tree becomes subjected. Though as yet it has not to my knowledge made its appearance in this vicinity, I am looking every year for them to come, not anxiously, however, for I know of nothing that would so completely prostrate my courage as a visit from so dreaded an enemy.

From the treatment as above stated, allow me to say that my anticipations are fully realized. Some of my trees have borne for three years. I have trees in my orchard that stand over fifteen feet high, thirteen inches in circumference, measuring half way between ground and limbs, and limbs three feet from the ground, a goodly number of which bore me fine fruit this past season. If my experience is a success, why may not yours be also?

I have said nothing as to the cultivation of pears, and having but little experience in this line, I shall omit speaking at length on this subject, but will give you as my opinion that they cannot be successfully raised in this locality to a profit; though with special care we may raise some pears, even here in Washington County. While I was in Massachusetts, a friend of mine in Northfield, Vermont, wished me to send him ten pear trees from Malden, Massachusetts. I did so; they were properly set, and made a fair growth

that season, but during the winter every tree died; they were grafted into the quince stock, and whether it was owing to the unadaptation of climate for the quince, or for some other cause, I am not able to say. Since I have been on the farm I have had a few pear trees, part of which are yet alive, which have borne a very few pears; but I could not recommend a very extensive cultivation of the pear here.

There is much I would like to say, but I have already trespassed upon your time, and I will close with a few suggestions to my brother farmers. Gentlemen, do you desire fruit? If you do, raise it; and if you would be successful, sow your own native seed; and when you graft, select none but the choicest varieties, such as are known to be hardy and prolific; then your trees will be already acclimated, and allowed to feed on their own natural element, and will thrive. Prepare your ground well; keep it well cultivated; take especial care in setting your trees that the roots and fibers occupy their natural position in the soil, without being cramped or crowded; limb your trees low, leaving them open-topped; prune well, and exercise good taste in the formation of your trees; wash thoroughly at least once a year; see that you master well your business, and not let your business master you; keep under subjection everything offensive to your trees, or that shall hinder their progress; keep well enclosed, and if you fail of success, just call on me for a barrel of apples from an assortment of forty kinds, or more.

Considerable discussion followed the reading of the paper, mostly upon the subject of cutting back the annual growth of apple trees. Mr. Andrews said this was his universal practice. He cuts back one-half or two-thirds of the annual growth on all young trees, every fall. Dr. Spaulding, of

Barre, never cuts back; Mr. Wheelock, of the same town, approves of cutting back when a strong and late growth is made. All are equally successful. Dr. Spaulding found that cutting back caused the bark to blacken below the cut, and injured the tree. His trees make a moderate growth, ripen their wood and drop their leaves early in the season. He saw no need in cutting. Mr. Andrews finds that unless he cuts back many of the branches die, and the trees are much hurt. It came out in the discussion that Dr. S.'s and Mr. A.'s orchards were on very different soils; the former having a gravelly soil underlaid with boulders, the latter has a strong, rich limestone loam.

# ORCHARDING.

AN ESSAY READ AT A MEETING OF THE STATE BOARD OF AGRICULTURE, AT MIDDLEBURY, FEB. 8, 1872,

BY Z. E. JAMESON.

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### THE OLD ORCHARDS.

I do not propose to mourn over the past. Apples were once in abundance, and apples and cider were a part of the winter stores of nearly every provident farmer. Now, there remain in all parts of the State the ruins of old orchards that have been planted on all kinds of soil, in various exposures and inclinations of land, and that have been treated to different methods of cultivation, as well as those that have suffered from total neglect. Seedling trees have died and grafted trees have died, and where once were orchards of five, ten, or fifteen acres, there now remain only a few scattering trees yielding but a meagre harvest at the annual shaking and beating.

Most of the old orchards were seedling trees. We are inclined to think that whoever sowed apple seeds, on newly cleared lands, soon had an abundance of thrifty trees, and the work of transplanting was the principal cost of the orchards. But many farms changed owners, and the orchards came to those who regarded them as so much real estate—as permanent property—and gave them no more care than they would give forest trees. No new trees were kept on

hand or purchased to replace those that decayed, so the orchard grew old and passed away, as the human race would pass away if no children grew up to fill vacant places or occupy new ones.

Apple trees have their old age, as one writer states, *Country Gentleman*, 1872, p. 6. "It is rare that apple trees live much over sixty years in the best fruit regions of the Eastern and Middle States, and rarely over forty at the West, and when they have thus fulfilled their destiny they may be discharged and new ones brought on." Some die by accident, some starve to death in barren soil, and some die by the inevitable weakness and decay of age.

In 1849 Chauncey Goodrich, of Burlington, wrote: "The most important question in fruit culture in Northern New England is, What is to be done with old orchards?" and further stated that the orchards that were thrifty and vigorous and heavily loaded with fruit forty years before, were at that time scrubby, worthless trees, filled with decaying limbs and sprouts, and gradually dying. He also quoted the method of dealing, which was made public in 1791, a method so meritorious that the British government paid the originator $20,000 for the secret of his process. Now if in generations past old trees demanded care and would die, we must conclude that among such a changing, speculative population as is in Vermont, the trees did not get proper and systematic care, and died more rapidly, until our land is now almost as free from good orchards as the world was free of people when Noah disembarked from his first and last voyage.

### HOW TO GET NEW ORCHARDS.

During the twenty-three years since Mr. Goodrich wrote, the question has changed, so that to-day we are not to con-

sider so much what we shall do with old orchards, as where we shall get new ones.

In solving this question, let me tell you what a man has done who depended upon himself.

### MR. DONEGAN'S ORCHARD.

Dec. 12, 1871, I visited the owner of the best orchard in Orleans County, Owen Donegan, Esq., of Troy. Twenty-seven years ago he sowed the seed. The small trees were grafted or budded with hardy varieties. Some of them were transplanted several times before they were set in the orchard, each time giving them more room until they were ten years old, when they were set in the orchard at the distance of 26 by 29 feet apart, at which distance Mr: Donegan expects their branches to meet in twenty years. He prefers to transplant several times, as it causes more small roots near the tree, and a tree properly raised can be transplanted when it is an inch or a little more in diameter as safely as at a smaller size.

In setting out a tree he digs a wide hole with a hoe, (using no spade,) about eight inches deep. He cuts off the tap-root of the tree every time, and places the side roots out horizontally, fills in among them some fine surface soil, and hoes some earth over them. Then he puts three large stones around the base of the tree. These stones settle the earth around the roots and keep the soil more moist and warm, and keep the tree in place, so that no stake is needed to steady it in the wind. When the ground is hoed the stones are removed, but are replaced again when the hoeing is finished.

There are about five hundred trees in this orchard that bear fruit, and many small ones, and the intention is to set out two hundred each year until the whole number is twelve

hundred. Then a few spare trees will be kept to fill the places of those that die.

In pruning, Mr. Donegan cuts down half the year's growth in the center of the top, and those cross branches that will be likely to touch each other in their growth. The side branches are allowed to extend themselves as far as they please. When loaded with fruit they bend down, almost or quite touching the ground. This facilitates the picking, which is done by hand. It is not easy to hire help that will exercise proper care in handling apples, therefore Mrs. Donegan is much depended upon. She told me she worked six weeks in the fall of 1871, picking apples. Early in September they commenced picking the Bon Sweet, a beautiful, luscious apple of large size and so tender that unless they were grasped in the whole hand in picking the prints of the fingers would soon be seen on its delicate surface as a bruise.

All the apples must be as carefully handled as eggs. They are laid in a basket, then picked from the basket and laid into the barrel, which is carefully filled so full that when the head is put in the apples must be pressed down an inch or so. This keeps them from moving and bruising in transportation. Mr. Donegan values his reputation highly, and insists that none but perfect apples be put into the barrels. Early one morning, while in haste to head up his full barrels to take to Newport, he saw two inferior apples on the top of one barrel, and nothing would satisfy him but the removal of all the apples to assure himself that his help had not carelessly put in imperfect fruit, but he found every one perfect except those two.

This year the Bon Sweet were sold at five dollars a barrel, and his other varieties at six. These varieties are the Brown Sweet, Fameuse, Blue Pearmain, Northern Spy,

Jewett's Red, (or Nodhead,) and Yellow Bell. He has also a few of other kinds.

His abundant crop brought him this year $800, and he experienced no difficulty in disposing of all he could spare, and, indeed, was so importuned that his reserved supply for home consumption is less than he desires. Two years ago the product of his orchard sold for $650, and for several years the crop has been abundant.

Three years ago a part of his orchard was injured by mice. He said, "I would not have had it done for a thousand dollars." I said, "You seem to value your orchard." He answered, "I would not take four thousand dollars for it, if a man offered me the money to-day. It pays me the interest of $7,000." Mrs. Donegan said, "Some folks think we are getting money very easily, but they don't remember that for the first twelve years it was all care and work with no pay. If I missed Mr. Donegan any time between sunset and nine o'clock at night, I was sure to find him in the orchard."

The bark lice have been an injury to some trees. To destroy them, a wash was made of water in which potatoes had been boiled, and lime and soap, making both a whitewash and soap suds. This was applied, after scraping the trees, spring and fall.

The method of cultivation practiced here was to manure and cultivate the ground for two or three years, while the trees were small, then seed to grass and mow four years, then plow and till two years, raising potatoes for a first crop and wheat or oats for the second; then re-seed to grass and mow four years again. The result is that he gets the most fruit the first year he plows, and the best growth in the tree the year after it is seeded to grass.

The sap suckers or woodpeckers have been an injury to

the Blue Pearmain trees, whose tender bark is easily pierced and seems to suit them. More than twenty birds have been shot the past year. The wounds from fine shot are not so much dreaded as the work of the bird.

The land is on a hill of moderate height; the inclination is in part toward the south and in part to the north-east, but Mr. Donegan would prefer a north-west slant, so that the sun would not start the growth of the trees too early in the spring. The soil I judge formerly supported a hardwood growth of maple, beech and birch. I am told that a ledge underlies the orchard at the depth of about two feet.

I have now given most of the facts that have come to my knowledge in regard to this remarkable orchard of choice fruit. This success has not been by chance, but by intelligent, persevering care. There is no doubt that many other farms are as favorably situated for fruit-raising, and that similar care would produce like success.

UNSUCCESSFUL ORCHARDING.

In renovating old orchards in Orleans County, several attempts have been made by former citizens of the western part of the State, by bringing scions from near their old homes, of very choice kinds. These grafts have usually grown very well the first season, and frozen to death the first winter.

In planting new orchards the inhabitants of Vermont have bought freely of standard trees from nurseries in New York. Many of the trees arrived in poor condition, and nearly all died. About eight years ago dwarf apple trees were sold very extensively in several counties, but some kind Providence prevented the agents from dealing in Orleans county. This was probably the most disastrous investment ever made by many farmers. The trees were in many cases set in gardens, or other nice, fertile land. They very

generally died, and those that lived were of but very little profit to their owners. They not only lost their money, time and care, but also their faith in orcharding, which, perhaps, was the greatest injury of all. For the credit of dwarf trees, I should say that a few lots did well.

Dr. McClearn, of Northfield, has some dwarf trees in his garden that have been cut back very closely, manured very highly, and in return bear some very fine fruit. The trees, also, of Wm. H. Loomis, of Northfield, are spoken of as bountifully productive. Very generally these trees are denounced in the most emphatic terms.

### NEW YORK GRAFTED TREES.

Within a few years several nurseries have been started in different places in Vermont from New York stock. The seed is sown and the grafting done in those large nurseries; then this stock planted and grown in Vermont, and the trees sold, when two or three years old, as Vermont trees. At Randolph, Waterbury Center, Northfield and other places this is the case. Indeed, some of the dealers in New York trees locate an imaginary nursery in the town they start from. The trees sold by these dealers are the Siberian Crab Apple, Transcendent, Hyslop, Soulard, Fancy Red, and Yellow; varieties of no special merit except hardiness. They also sell, as crab apples, the Russian varieties, Duchess of Oldenburg, Emperor Alexander, Red and White Astrachan, and Tetofski, and also a few hardy English or standard apples. These trees have been sold only a few years, and have not been fairly tested. A few, however, that were expected to bear a desirable apple, only produced a small inferior crab.

### TREES FROM SEED.

Some farmers have a few trees growing from seed of their own planting. These trees are apt to be neglected. The

lower branches are suffered to grow until of such size that a dry, dead knot is left when they are cut off, which sometimes kills the center of the tree, making it "black-hearted."

These side branches often take so much of the strength of the tree that it really has more low lateral growth than upright growth. Then I see them growing closely together in a neglected state, surrounded by grass, with branches and roots thickly interlaced. I have also seen such trees transplanted to the orchard row, with so many places where the branches have been cut away, that it would be a marvel indeed if they ever became thrifty trees.

It is without doubt true that the common native seedling will not be as hardy, on an average, as trees that are all grafted so that the body and top is entirely of a hardy sort. Then the grafted tree, if grown by a careful nurseryman, has every advantage over the chance seedling. Its growth has been in good soil, so that it has not been stunted, the small branches have been removed while small and tender, so that the wound soon grew over, and made a smooth trunk of white, healthy wood. Then many native trees are slow growers, shy bearers, and after patient waiting produce fruit which is nearly worthless. Nurserymen should have varieties that are strong growers, early and prolific bearers, and producers of fruit of excellent quality.

### VERMONT NURSERIES.

There are several nurseries in Vermont that have no connection with those in other States, but contain trees of hardy varieties, the result of painstaking and persevering experiments.

### VARIETIES AND CULTIVATION.

I will now briefly speak of the history of each tree. To obtain seed to sow, the apples are ground up for cider and the pomace sown in the fall. The next summer three

or four hundred thousand trees make a growth of from one to two feet in height. In the fall all these little twigs are taken up, assorted, counted and packed in the cellar to be grafted in the winter. Some of the smallest are too small for grafting, and are grown another year and budded. In grafting, each variety is kept by itself, and in spring the stock and scion united are carefully planted in straight rows, five or six inches apart, while the rows are four feet apart, in ground that is well prepared.

The first season they are not trimmed, but are hoed carefully and manured with ashes. The second year they are trimmed twice, pains being taken to secure a rapid upward growth. The land is also well tilled. The third year they are tended as carefully, trimmed twice, and the leaves rubbed off upon the lower part of the tree. Also many stakes are used, to which the crooked trees are tied to straighten them.

The three year old trees are large enough to sell, and are perhaps the most profitable to buy. The trees from the nursery are delivered fall and spring. The trees that are old enough to sell are labeled, while they stand in the nursery, with the name of the variety, and every care is taken to prevent mixing varieties, and mistakes in filling orders.

### PACKING.

The trees are packed for customers in a building 25x75 feet. There are tables along the middle, and on each side are small stalls, that will hold an armful of trees. Each variety is put into a stall of that name, and the packers very rapidly gather a bundle such as the customer desires. Straw and damp moss envelope the roots, and large lots of trees are packed in boxes, or in sacking secured tightly around them. They generally reach their destination in good condition.

### CRAB STOCKS.

There are a few inquiries that are often made, and which should be considered in this connection. They are these:

1st. Does grafting on the Siberian crab root make the tree any hardier?

2d. Does it make a long lived tree?

3d. Does it dwarf the tree?

4th. Does it injure the quuality of a nice variety of apples to grow upon it?

1st, then, does it make the tree hardier?

There is no tree hardier than a crab apple tree. It flourishes in Canada, and grows of such size that as many as thirty bushels of apples have been harvested from a tree. In Vermont I have found several crab trees that apparently came by chance, and some of them bear a fruit of considerable value. Recent travelers in Kansas assure me that there are groves of crab apple trees in that State that are very old —some a foot in diameter—all bear a green sour apple from three-fourths of an inch to two inches in diameter. Scores of years have passed since these trees started from seed sown by natural means; no man's labor aided their propagation. We can then call this a native of the American soil. Although belief is expressed by some that in former times that country was inhabited by an intelligent population who had orchards and grafted upon the crab stock, the good fruit has all passed away, leaving the more hardy crab tree, with its symmetrical top and profusion of fruit as the only vegetation that has survived until the present time, as the fruit of their labors. I am told that by burying the apple in the ground a few weeks the bitter and extreme acid taste is taken away, and they become quite palatable, and of a bright yellow or golden color.

Ben Perley Poore, who wrote of the agriculture of the

Indians, *Agricultural Report*, 1866, p. 499, says 'mishimin' signifies apple, and old accounts of early voyages "reckon apples among the early native fruits." And unless crab stocks were found, it does not appear how the large orchards mentioned by early writers could have been made productive so soon. In 1635 a Mr. Wolcott wrote, "I made 500 hhds. of cider from my own orchard." This was not more than five years after settlement.

While all admit the hardiness of this tree, they are not so well agreed that by engrafting the English or standard apple upon the crab root, the tree growing therefrom will be hardier than upon a stock grown from a common apple seed.

Some say that the root of the tree does not die, even if the top is killed by untimely freezing or other adverse circumstances. "If a tree die there is hope that it will sprout again," and a succession of tops flourish and pass away from the same root, therefore its hardiness is proved. Not so: If the tree stands in a poor barren soil, where grass and weeds make but a stunted growth, it may grow a year or a few years, but there is not enough fertility to cause a continuous growth of healthy wood and luscious fruit. Such barrenness of soil brings disease and decay to the tree. It dies; the root again throws up vigorous sprouts that flourish for a while, then pass away to be again succeeded by other sprouts.

Soil and root bear a relation to each other, like a small pasture that can support a calf or yearling, but in which the full sized ox, instead of developing into splendid beef, would die of starvation. The pasture cannot furnish food for a mature animal of that kind. It is well known that the fir, spruce or pine will often make a vigorous growth where some other vegetation would entirely fail. The roots

of some trees can and do adapt themselves to their location, and thrive where a grape vine, pear, or even grass will not grow. The brown and black ash, the cedar, tamarac and black alder will thrive where the soil is full of stagnant water, and is often overflowed. The sugar maple, beech, white and red birch, and pine delight in dryer soil.

2d. Does this process make a longer lived tree?

There are many evidences that the crab apple root, being more fibrous, occupies the ground more completely, and is more likely than any other to give an even, continuous and vigorous growth to the tree.

Mr. Charles Walling, of Montpelier, says: "About twenty years ago, while grafting some seedling trees for my own use, I grafted one crab apple seedling, and while all the trees upon the common stock are now dead, the one on the crab apple stock has been and is now a vigorous and productive tree.

"During the last fifteen years I have grafted many crab apple seedlings for myself and others, and my success has been such that I can confidently recommend it to others. I could not be induced to use any other." This testimony was given in October, 1871.

3d. Does it dwarf the tree to engraft the English or standard apple upon the crab stock?

My impressions are that the crab apple tree grows as rapidly as the common apple tree, therefore, the root that will support the one in so uniformly thrifty growth, will support the other. Then the junction between stock and scion will be harmonious and symmetrical, presenting less contrast in size than is often seen in old orchards where the engrafting has been done in the heads of trees. If the arguments are sound that prove the hardiness of this stock, they would have a tendency to prove that a root that occupies the ground

so well, and supports a tree until old age in a thrifty, productive condition, cannot dwarf the tree at the same time. And, further, it would be reasonable to believe that the root that can support so productive a tree as the crab apple, loaded year after year, and often breaking down with its burden of fruit, can and does give *more* than the usual or natural growth to the common apple, that seldom or never is so productive.

4th. Is the quality of a nice apple rendered inferior by being grown on this stock to what it would be if grown on common apple stock?

It is often said by men dealing in trees that the crab root injures the quality of the good fruit grown upon it, but I have imagined that this statement was made because it is more difficult and costly to get crab seed to sow. But when they discard the crab seed they use the common cider apples —the most defective and meanest of the apple crop. If these trees were permitted to bear natural fruit, most of it would be small and of poor quality, as is proved by the many natural orchards in the country; therefore, if the crab stock is very objectionable, the common stock must be undesirable, and the whimsical or conscientious nurseryman must get seeds from large mild or sweet apples to ensure the best quality of fruit.

But such painstaking is impracticable and unnecessary. A great amount of evidence can be collected to prove that apples of large varieties grown on crab stocks are of large size, even to fifteen and a half inches in circumference, and that sweet apples are sweet every time. The Astrachans are still early fall apples, and the Nodhead, Bethel, Hopkins' Porter, and Derby Seek-no-Further are each true to their character in flavor, size, color, and keeping qualities. Indeed, whenever a case of variation is caused by the stock,

it excites such surprise that it seems to be mentioned as an exception to a general rule.

Even if it was plainly proved that *very rarely* a good apple becomes somewhat inferior on this stock, it would still be best to buy and cultivate these trees on account of superior hardiness and productiveness, always bearing in mind that we live in a severe climate, where the choicest fruits cannot be raised, and where other fruits, such as pears and grapes, are doubtful experiments. If apples can now be surely raised, of certain varieties, and by a special method, we should not hesitate to accept the sure, safe and reliable way, even if, in very rare instances, a slight change of flavor be found against the crab stock.

Hon. Henry Lane spoke briefly in opposition to the plan of planting crab apples as an orchard fruit. He thought no one who did it would fail to regret money thrown away and time wasted.

He did not think the crab would prove as good for stocks as the common apple. In his experience the chief difficulty in raising trees was in the body, not in the roots, and he could not see any advantage in using the crab for stocks.

Dr. Hoskins, of Newport, followed Mr. Lane, and expressed his views against using crabs for stocks. His experience in Maine and Vermont confirmed his observation against the theory. He instanced the orchard of Mr. Dugan in Orleans County, and another in Caledonia County, the only two successful orchards in the extreme north-east part of the State; both were on common apple roots, and were thrifty and healthy, while no successful orchard of any age could be shown on crab apple roots, although the crab stock theory had been advocated nearly twenty years, and orchards had been planted with them nearly that time.

Mr. Jameson thought crab apples were unequaled for cooking purposes, and his opinion in this respect had been confirmed by gentlemen in Massachusetts, where common apples are abundant and cheap. He gave a statement of sales of crab apples from Northern Vermont in the Boston market at very remunerative prices.

Dr. Hoskins said that on their way to attend this meeting his friend Jameson had intimated that he was going to read a paper that he thought would act upon him somewhat as a red rag is said to affect a bull. But he was sure that all the audience, as well as himself, had been much gratified and instructed by the excellent paper they had just heard from Mr. Jameson. Indeed Mr. Jameson never presented anything to the notice of his hearers that was not eminently worthy of their attention. It is true, he differed with Mr. J. somewhat in his estimation of the value of the Siberian crab and its hybrids as an orchard fruit, and also in his views in regard to the crab as a stock upon which to graft the common apple. He believed that the Siberians (with perhaps a very few exceptions) were of no value as a table fruit. He thought it must be a very polite guest who would not decline a second apple of this kind, if offered him at dessert. It is claimed for them that they are valuable for cooking, but from his experience he was convinced that the extra sugar required to make them palatable would both buy and sweeten much better fruit. As to their value for cider, nearly every variety of them now cultivated is ripe and gone before the proper time comes for making cider. Some of them, however, do make very good cider, but not preferable, to his taste at least, to the choicer cider apples of the common sort, that are equally hardy and better for all other purposes.

As a stock for grafting, they were liable to one very serious objection. The Siberian is a different species from the common apple—as different as the pear is different from the quince,—and we all know how uncertain the quince is as a stock for the pear, that it modifies not only the growth of the tree, but also the size and quality of the fruit. This is equally true of the Siberian crab when used as a stock. It transmits somewhat of its own bitter, austere nature to the fruit of the scion, and this to the extent, in many cases, especially of the finer fleshed and flavored sorts, of rendering them quite valueless as table fruit.

It is claimed that in some sections it is necessary to graft the common apple upon the crab for the sake of hardiness. But he appealed to the many intelligent orchardists present if they ever knew an apple tree, destroyed simply by climatic causes, to die first at the root. He was sure that this was never the case, and that therefore there was no necessity for having the stock any hardier than the scion. And in fact the hardiest of all our common apples, a variety that can be cultivated as far north as any Siberian, (Duchess of Oldenburgh,) does not succeed upon the Siberian stock, and is not grafted upon it by the very men who make this claim of necessity for using the crab stock. And another significant fact might be mentioned, that though this fashion of grafting on crab had been pushed in his own and Mr. Jameson's section for nearly twenty years, the only remarkably successful orchards there are not on the crab stock. The whole idea was, in his view, based on error, and perpetuated for pecuniary motives.

Mr. Wright, of Middlebury, said he did not care about this crab question. They are entirely valueless, in his opinion, for any purpose. But a dishonest man will sell twenty

times as many trees as an honest one, because he is a smooth talker, and makes it his business to take in the public. He preferred to take the old way, which had always succeeded with him. He thought with care the common stock would always prove satisfactory, and without care no stocks would save trees from destruction. (Mr. Wright exhibited a very nice assortment of apples in fine order, including Ramsdell's Sweet, Tinmouth, Swaar, R. I. Greening, Red Canada, Baldwin, Northern Spy, and some others.) The way to make apples keep is to pack them in open barrels in a good cellar and not to handle them. Nothing hurts apples more than to pick them over. In growing an orchard, he would study nature, and keep as near to her as possible. Give care, constant care, to your trees; that is the secret of success. In gathering, remember that winter fruit may be left on the tree too long and become over ripe. Such fruit will not keep well. Harvest when the growth is complete; they are then tree-ripe. In the after ripening, sugar is formed, and the fruit becomes eatable. Low temperature and a dry air will retard this much. A constant temperature of 34° is the best to keep apples. So kept, they may be marketed in June at the highest prices. Prune the trees moderately, and do it early in the spring, before the sap starts. Secure a uniform product by thinning the fruit on the tree, otherwise you will exhaust your trees and ruin prices.

# PEAR CULTURE IN VERMONT.

A PAPER READ BEFORE THE VERMONT BOARD OF AGRICULTURE, &C., AT MONTPELIER, FEB. 21, 1872,

BY HENRY LANE. ESQ., OF CORNWALL.

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In the paper I shall read at this time, I shall give you only my experience and observation, in relation to pear culture. An experience of twenty-five years has taught me how little I knew about pear culture when I commenced, and it has also taught me how much there is to know, that I don't know. Could I have had my experience when I commenced pear culture, I should have avoided many mistakes and failures, loss of time, labor and money. As valuable as my experience is to me, it may be of but little value to any other person. My experience on my soil may not be applicable to your soils. The different kinds of soil, the variations of soil, the various conditions of soil, made so by drainage, by tillage, by manure, by the different modes of the application of manure; the location, whether level or sloping, gentle or rapid, southerly or northerly; the difference in altitude, the exposure to or protection from free currents of air, near or remote from a large body of water, on the hill or in the valley. No two persons are the same in all these conditions; each is peculiar to his local circumstances and surroundings. So many influences and conditions affect the result that disappointment follows when a course is pursued as laid down by our best pomologists, and

on what appears to be the best of soil. I followed the experience of Wilder, Downing, Barry, and Thomas, each successful pear culturists. I made mistakes and met with disappointments. It will not do to follow all the recommendations as laid down in the books for the propagation and management of fruit trees. Still the beginner needs some guide in the operation of culture and selection of varieties. He should use all the knowledge he can obtain from others, always remembering that skill and success is acquired by one's own experience, combined with persistent industry and close observation.

In a tropical climate nature offers to man, almost without care or labor, a variety of nutritious and delicate fruit. Here in Vermont, our climate wears a stern and harsh aspect. Our season of ice and snow, of cold winds, lasts nearly six months of the year. Our climate is trying to fruit trees, especially to pear trees, both summer and winter. The genial warmth and sunshine of our summers produce a vigorous growth, but quite too short to ripen the wood of many varieties sufficiently to withstand the rigor of a Vermont winter. Pears have long been grown in certain localities, in limited quantities, in our State. I think they may be grown in many other places and in more abundance. We are beginning to learn what varieties are adapted to special soils and localities; what varieties are hardy enough to withstand our climate. Amid the great number of excellent kinds we should be able to find some that will succeed in nearly every, even the most unfavorable, location.

If we look at the past history of pear culture in this State, gloomy as it may appear, we may be able to discover some of the causes that prevented a success, and by avoiding our past mistakes to succeed in the future. There have

been thousands of pear trees sold in the State by nurserymen and their agents; a large proportion of them grew out of the State, propagated in a soil unlike that in which they were planted, forced to an unnatural and tender growth in the nursery, mutilated in their removal and handling, too long out of the ground before transplanting, an extended list of varieties selected for their size and excellence of flavor without regard to their vigor, entirely unsuited to withstand our severe winters. "It is estimated that not five per cent. of all the trees sold by nurserymen, and planted in this State, live to their tenth year; that ten per cent. never reach their fifth year, and produce little or no fruit." This estimate, gloomy as it may look, I think is more favorable than the facts will warrant, certainly if we except this locality, this section of the State bordering on the beautiful lake west of us, favored as it is by the beneficial influence such large bodies of water have upon fruit trees. Except this section of the State, and I do not believe two per cent. of all the pear trees planted during the past twenty-five years have reached a profitable maturity. Vermont pear growing, if not altogether a failure, has been very generally so — twenty failures to a success.

There are various causes for this general failure — the tree, the variety, the management. Seeds have been taken from fruit of diseased trees, or from those known to be tender in their wood. Nurserymen, in order to meet the great demand for large handsome trees, stimulate their growth by a profuse application of manure, a practice that will produce a succulent, unripened growth, a sure precursor of blight. Such trees are almost certain to be killed by frozen sap-blight during the first or second winter after planting. Trees are dug with too little care; three-quarters of their roots are left in the ground; what remain with the tree are

mangled and bruised; varieties are selected too tender to stand our severe winters. Our general system of management has been radically bad. The fault is not in the nature of the pear tree or our climate, or in our soil, but in the system of propagation, selection of varieties, and culture.

### THE NATURAL PEAR.

Perhaps no fruit is farther removed from its natural form than the pear. Man, by his industry, skill and perseverance applied to the wild choke pear of our fields, in its natural state one of the most astringent, unattractive, worthless fruits, has transformed it and produced the rich, sugary, melting, delicious Bergamots and Seckels. The various processes that have brought about this change from the natural form to these artificially created varieties, has made it less hardy and more liable to disease and decay. The pear tree in its natural, wild state, is longer lived than the apple, more vigorous in its growth, healthy and hardy as the beach and maple of our forests. There are specimens of pear trees in different sections of our country remarkable for age, great size and productiveness.

One of my earliest recollections of fruit is that of a pear tree standing in a neighbor's apple orchard, an orchard of mature age and size. The pear tree, with no extra care, was in size, vigor and productiveness, equal to any tree in the orchard. I used to visit this tree with the owner's son. My childhood recollection will pronounce this pear in quality equal to the best varieties grown now.

We find, in different sections of our State, trees standing perhaps where the seed was planted, that have attained great size and age, producing large crops of pears of fair quality. From these grand old trees we may learn a lesson. From the first planting of the seed, through all the nursery treatment and orchard culture, we follow a plan precisely

contrary to nature. Let every man, who can, grow from seed his own trees, bud or graft them where they are to stand in the garden or orchard. Any one who cannot do this (and I think many will fail who attempt it) should select trees grown on a soil like that in which they are to be planted. Purchase of nurserymen that use thrifty, hardy stocks, that do not stimulate too rapid and tender a growth; select only such varieties as are known to be hardy and productive in your locality; get your trees from the nursery as young as possible, that they may suffer but little from shortened and mangled roots. I would advise every man who owns land, if it is but a garden plot, to have growing upon it at least one pear tree.

To any who wish to grow their own trees I would say, select seeds from some healthy, vigorous tree, of common quality. The wild-choke pear, having large and full developed seeds, is the best. Gather the seeds when fully ripe. Sow as soon as cleaned, or at least before they become dry. I have found it more difficult to raise good pear stocks than of any other kind of fruit. The seed bed should be a deep, rich soil; a rich mould from new land is best. It is important to secure a large early growth so that by mid-summer they will be from twelve to eighteen inches high, and of stocky growth. In this I fail two years in three. There are two principal causes of failure. If we fail to secure an early growth, the trees are generally attacked in the hot summer months by an insect, or a sort of rust, that appears on the leaves. The growth ceases when these appear, or if the trees continue late in growth and an early freeze overtakes them when the wood is unripened, the frozen sap-blight destroys them. When I fail to get good stocks the first season, I think it better to try again rather than attempt to make anything out of those that have been injured by in-

sects or disease. Nature is the most successful tree grower. I would follow her so far as possible, and plant the seed where the tree is to stand. I know this cannot be done except to a limited extent.

In the summer of 1855 I succeeded in raising a fine crop of seedling trees. The fruit of these trees was changed to several choice varieties, some before and some after their removal from the seed bed. I left one tree, and that is the only tree in my orchard that stands where the tree was planted. This was budded to the White Doyenne. The tree commenced bearing young, and continues to give me a yearly crop of the finest Doyenne pears, in size, color and quality, of any I have ever seen. Out of twenty trees of this variety, some of them raised at the same time of this one tree, only differing in being transplanted, none produce fruit in any respect equal to this tree.

I would remove the pear seedling after one or at most two years growth, and plant in the orchard where the tree is to remain. Every one who cannot raise his own seedlings, (or who *will* not,) I would advise to purchase them of nurserymen, instead of purchasing trees after the fruit has been changed, and I would advise nurserymen to furnish good, healthy, hardy seedlings to his customers. After the seedling has been planted in its final position in the orchard, leave the side shoots and leaves to give nourishment and growth to the stem, removing them gradually when the stem has become stocky. Let the top form about four feet from the ground; would rather have it five than three. There are serious objections to the low trunks so much in favor a few years ago. The principal reason in favor of the low top was to protect the trunk from winter blight. A more safe protection is to change the fruit of the tree in the top instead of making the change at the root, thus securing a

trunk perfectly hardy, almost secure against blight. (I have never lost but one tree from blight where the fruit was changed in the limbs.) Change the fruit by budding or grafting the limbs at least one foot from the junction with the stem; in most instances, two feet is better; the main object is to retain all of the hardy stock you can.

### SOIL.

A strong loam soil is the best for the pear tree. A loamy clay, where the clay largely predominates, is favorable for this tree. If on clay soil, plant entirely above the natural surface of the ground and cover their roots with mounds of earth instead of planting them in holes. Soil that is damp during a considerable portion of the year, or where the subsoil is so wet that the roots will come in contact with standing water, should be underdrained. Most clay lands will be benefitted by thorough drainage. A low, wet, frosty location should he avoided; elevated localities are the most favorable. I would obviate the old plan of digging large holes for my trees by a thorough preparation of the whole ground where the orchard is to stand.

Twenty years ago I planted an apple orchard of four acres, 40 trees to the acre. This field had been cropped for many years to corn and wheat alternately. A heavy coat of manure had been applied every two years; the land plowed deep. This was as good a preparation of the soil for setting trees as one could well give it. Inexperienced as I was in setting fruit trees, I sought the experience of others. I read *Downing's Fruit and Fruit Trees of America.* He told me to dig my holes from three to four feet square, and eighteen inches to two feet deep. Desiring to be thorough in my work, I followed the outer extreme. Taking one man with me, we went to work throwing out thirty-two cubic feet of soil for each tree, a quantity that

weighed not less than two tons. The ground was filled with small stones, especially the subsoil, and was hard to dig. Four holes each was our day's work, and a hard one at that. According to directions, I mixed with the earth, when replaced in setting the tree, compost manure prepared by mixing muck and ashes with well rotted manure, using five bushels to each tree. After setting one acre in this way, being somewhat tired of so much expense and labor, I lessened the size of the holes dug on the second acre to three feet by eighteen inches. I found quite a difference between removing thirty-two, or thirteen and one-half feet of soil. On the third acre I dug the holes two feet square by one foot deep. The fourth and last acre was set by digging the holes just sufficient to accommodate the roots without bending or crowding. These were set without manure. The trees on the last acre, from the first, commenced as vigorous a growth as the trees on the first acre, and at this time are equal in size and productiveness. Scarcely a tree on the first acre stands erect. The soil replaced in the holes before the tree was planted was packed as well as it could be done when the earth was dry, but the decomposition of the manure and heavy rains settled the ground unevenly, leaving the trees leaning, some in one direction, some in another.

Except for the first pear set out twenty-five years ago, I have never dug holes larger than was necessary to place the roots in the same direction that they grew before the tree was taken up for transplanting. My dwarf pear trees were placed upon a rich sod, inverted, in the bottom of each hole. Standard trees should be planted from fifteen to twenty feet apart. Dwarf trees from eight to ten feet. Some varieties require more space than others. Most persons think a wet time the most favorable for setting trees, and if the weather is dry when their trees are received, will head them in or

place them in some damp place like the cellar, and wait for rain. Trees should not be set for two or three days after rain. If the soil is wet it falls upon the roots in heavy clods, pressing them down together. If dry, the soil can be sifted among the fibrous roots, separating each rootlet from its fellow. Roots are thrown out in layers so as to reach different strata of earth. In setting out the tree, the upper layer should be raised until the lower roots have been placed in their natural position and covered with fine earth. Place no two roots in contact. After the upper layer of roots has been placed and covered, thoroughly saturate with water. If the weather is dry, mulch the tree. Never water a tree at any time after it is planted. Retain the moisture by thorough mulching, or create moisture by thorough culture. It has been said that "a man can create more moisture with a hoe than with a watering pot." I do not favor mulching trees after the first season of planting. I prefer good culture often stirring the soil, to mulching. A pear orchard should be kept clean from weeds; should receive as good culture as ought to be bestowed upon corn or potatoes. To avoid a late growth of wood, I do not cultivate the ground after the first of September.

## DWARF OR STANDARD TREES.

Which shall we set, dwarf or standard trees? In answering this question I will say that I have planted both in about equal numbers. Should plant both again, but select fewer varieties. Dwarf trees require more attention, and will suffer more from neglect of culture, therefore should not be planted by any one who will not give care and culture to his trees. Dwarf trees can be made profitable. The crop returned in quantity and quality will be about in the same ratio of the amount of culture and care given to the trees. But few persons will give them the requisite care to insure

success, hence but few persons should plant dwarf trees. Standard trees, after the first few years, will bear a degree of neglect, and as there is no trouble in finding in every community persons that will neglect their trees, they had better plant standards.

VARIETIES.

There is an almost endless number of varieties, very few of which have proved of real value for any given soil or locality. Opinions differ much as to the merits of some sorts. High flavor and handsome appearance must be sacrificed to hardiness and productiveness in our severe climate. One of my mistakes was in selecting too great a number of varieties. Many have proved almost entire failures. The selection of varieties is one of the causes of failure in pear culture in this State. It will not do to select from any list recommended in fruit books, nor from lists recommended for different States by committees appointed for this purpose by pomological societies. One variety may succeed perfectly in one section, and be ill adapted to another. The Baldwin apple does finely on Shelburne Point and vicinity, while it is a failure with me. Select only such varieties as are known by ample experience to be hardy and productive in the locality where you are to plant them. My faith in the Flemish Beauty, as the one best pear to grow as a standard in my section, has been somewhat weakened by a disease that has attacked the fruit the last few years. The fruit some years is covered with dark mouldy specks. These specks appear when the fruit is scarcely one fourth grown. It prevents the fruit from growing to its full size, and it does not have its usual color or quality. I have tried to ascertain the cause of this disease, but thus far have not been able to arrive at any satisfactory conclusion. The Flemish Beauty is

certainly one of our best pears. The tree is perfectly hardy, luxuriant in growth, and bears early and abundantly. If the fruit proves worthless one year in three, I would still plant of this variety. I know of no variety more hardy, which is very important for our State. The Bartlett pear, ripening as it does just before our fall pears, its size, beauty, excellence and productiveness, make it a valuable variety. Where it can be grown, it has no competitor as an early fall fruit. The Bartlett, unlike the Flemish Beauty, is very tender. It grows vigorously for two or three years, and is almost certain to be attacked with the blight before coming into bearing.

I have purchased of nurserymen at different times thirty trees, and not one lived to exceed three years from setting. Out of all the Bartlett pear trees set in this State, trees where the fruit was changed at the roots, I do not believe two per cent. have reached their fifth year. I raise the Bartlett pear successfully, but only on trees raised myself, and where the fruit was changed in the top. The blight almost invariably attacks the stem of the young Bartlett pear tree. If the stem and lower part of the main branches are of some common, hardy stock, they will succeed. I have succeeded by double working the Bartlett on the Flemish Beauty tree. The White Doyenne is hardy with me, but not as vigorous in growth as the Flemish Beauty. The tree is productive. This fruit, unlike that grown in many sections of our country, on my soil never cracks. These three varieties, the Flemish Beauty, Bartlett, and White Doyenne, are the pears I would raise for market, and no other on standard trees. The Madeleine for its extreme earliness, the Seckel for its spicy, honied flavor, the Bergamot for its rich, melting, sugary flavor, and many others that might be named, are desirable varieties for the garden, but of the

long list of varieties, discerning amateurs will be enabled to select a variety of hardy pears ripening in succession from the middle of August until mid-winter.

In 1861 I set seventy-seven dwarf trees, selecting from the list recommended by Barry. I selected twenty Louise Bonne de Jersey, fifteen Duchess d'Angouleme, ten White Doyenne, four each of the Flemish Beauty and Vicar of Winkfield; of other varieties one or two trees each; in all twenty-five varieties. I will not take time to mention the defects of those that do not succeed; more than one half of them are a failure either in hardiness or quality of fruit. The Louise Bonne has proved a success beyond my expectation. This tree is perfectly hardy, very productive, fruit large and of excellent quality. At the rate these trees have produced since the fifth year from planting, and at the price the fruit has brought, an acre of this variety would bring not less than one thousand dollars yearly. For market I would set no other variety. I have heard it said that this variety on the quince root "would never root from the pear." One out of my twenty trees has thoroughly rooted from the pear stock. The fruit on this tree is quite inferior in size and quality—would not bring half price in any market. The Duchess has been a profitable dwarf pear in many localities where the climate is a little milder than ours. My trees of this variety make a rapid growth yearly, but fail to ripen their wood sufficiently to withstand our winters, are not productive, quality of fruit third rate. White Doyenne is better on the pear root. My Flemish Beauties have, every one of them, rooted strongly from the pear stock. I have removed the lower limbs, and changed them to standards in all respects, but lost not less than three years by their being first dwarfs. Beurre Diel, Beurre Langelier, and Belle Lucrative have done very well as dwarfs.

## PRUNING.

Standard pear trees need but little pruning except when young. When the tree has been removed, prune off the branches in proportion to the loss of roots. Nearly all after pruning will be just sufficient to give shape and form to the tree when young. The sap of the pear tree flows most freely and readily to the upper branches, giving them vigor and uprightness, to the checking of the growth of the lower limbs. We must head back and check the leading shoots to preserve the development of the lower branches, to give sufficient breadth of base to the tree. Dwarf trees require more and in some respects different pruning. One of the most successful cultivators of the dwarf pear, T. G. Yeomans, of Walworth, N. Y., has said that "the indispensable requisite to success is thorough pruning." My observation confirms the statement of Yeomans. Dwarf trees should be transplanted when two years old. The lower branches should be allowed to form one foot from the ground. Prune to the pyramidal form. As the greatest force of sap will flow to the upright branches, they need to be cut back most. Unless you check the flow of sap to the upper branches, and induce it to flow more forcibly to the lower side branches, when young, you can never after develop the lower branches.

In pruning to keep the symmetry of the tree perfect, if the side branches are too horizontal, upper buds are left for their extension; if too upright, lower are left; side direction is given in the same way. I prune in the spring just before the buds open, removing from one half to two thirds of the previous year's growth. If the tree lacks in vigor, trim a little closer. Vigor and longevity of dwarf trees depend upon the amount of pruning they receive.

## DISEASES OF THE PEAR.

Among the many obstacles that the pear culturist has to contend with, the blight is decidedly the worst. There are two kinds of blight, the frozen sap blight and insect blight. The insect which causes the blight deposits its eggs sometime in July or August just below a bud, generally on a shoot of one or two year's growth. After the egg hatches, the small grub burrows towards the center of the stem, cutting off the vessels which carry the ascending sap. At the very first indication of the disease the branch should be cut off and burned. I have not been troubled with this disease for the last ten years. Previous to 1860 I lost several from this insect.

More trees are lost from frozen sap blight, than from any or all other causes. It is the great hindrance to the otherwise easy and profitable cultivation of this fine fruit. This disease is caused by a late unripe growth, and by the winter overtaking the tree before the wood has fully ripened. The only remedy is a preventative one. Do not make your soil over rich. Avoid summer enriching or stimulating the tree. Remove all excess of water in the soil by drainage. Give good culture early to obtain an early growth, but cultivate none after mid-summer. Every diseased branch should be cut away at the earliest moment after it appears, cutting below the lowest dark spot on the bark or wood. In the spring of 1870 I set forty pear trees. That year there was but little rain from early spring until past mid-summer. The fall was warm with abundant rains. These trees grew but little the first half of the season but commenced a spring-like growth in October. Those that had fruit buds blossomed in November. Thirty of these trees died the next spring. Such remarkable seasons cannot be prevented.

### INSECTS.

The borer, the great enemy of the apple tree, fortunately does not trouble the pear. The caterpillar and canker worm, nearly the same that trouble apple trees, sometimes increase in numbers and size with great rapidity, and should be crushed at their first appearance. There is a slug that sometimes attacks the leaf, eating out the succulent part of it. When this has been done to any considerable extent the tree and fruit are stopped in growth. Lime or ashes dusted on this slimy insect is sure death to it. This insect has never troubled me except in the summer of 1866.

### THINNING FRUIT.

Varieties like the Bartlett and Louise Bonne de Jersey commence bearing young, and are inclined to over bear. Trees for the first five years should bear but few specimens. Remove all fruit from weak branches that they may overtake in growth the stronger, and thereby complete the symmetry of the tree. If one-half of the fruit is removed from an over bearing tree the remaining half will be worth more than the whole if allowed to remain on the tree. Thin when about one-fourth grown. At this time the imperfect fruit, those specimens which if allowed to remain would be worthless, can be detected. Many trees, if allowed to perfect all the fruit they will when young, will so exhaust themselves as to scarcely ever recover from it. Important as it is to thin their fruit, very few persons ever practice it.

### GATHERING.

The pear unlike most all other fruit should not be allowed to perfectly mature on the tree. Some varieties, if ripened on the tree, are nearly worthless, but if gathered at the proper time possess the richest flavor. Gather when the fruit begins to fall. With some varieties it will hardly do to wait

for this, but they should be picked when the stem will cleave from the spur without breaking. The Bartlett and Flemish Beauty will be good if picked before fully grown. When harvested, pears should be placed in a dark, cool, dry place.

### COLOR.

Color is very important to a grower of the pear for market. Color depends on soil, elevation and humidity of climate. Light colored soil gives our highest colored pears. The hill or elevated plain gives handsomer fruit than the alluvial flats. On the lowlands along our rivers the fruit will remain of a dull, cloudy green, entirely destitute of that high color so desirable in the pear. According to my observation, trees standing where the seed was planted, without root pruning to prevent the roots striking deep in the subsoil, will produce higher colored fruit than those trees that, when young, have their tap root cut and thus encourage the throwing out of branching roots into the surface soil. This question of color requires of the pear culturist close observation and study.

Fruit culture has a beneficial influence upon the health, habits and tastes of every family. It is desirable for every man to provide fruit for his family, and if possible to cultivate the trees in his own garden, with his own hands. A large majority of the rural population in our State own the houses in which they live, and the land surrounding. Upon many of the farm houses much care and expense has been bestowed to the almost entire neglect of the exterior, the fruit garden, and home surroundings. A large number of our farmers' homes are naked, not a single ornamental tree in the yard or fruit tree in the garden. Such places lack the comforts and influence of a permanent home. The children in such homes will have the spirit of unrest. How changed the aspect of a farm home by surrounding it with

trees that combine the useful and the beautiful like the pear tree. It increases the love of home, tends to strengthen our habits and elevate our characters. It should be a pleasure for every man to beautify his home. The natural scenery of our State is diversified and beautiful. Make our homes and their surroundings equally beautiful, and there is no place more desirable than our own State. No place or home will be complete without that tree above all trees, the pear, in symmetry and proportion one of the most beautiful trees the eye can rest upon; in the spring it puts on its snowy dress of blossoms, followed by foliage of the richest verdure; in the autumn bending with its load of ripe, delicious fruit. Farmers, plant more pear trees.

D. B. Wheelock, of Barre, inquired of Mr. Lane in regard to the Louise Bonne de Jersey, whether best on pear or quince. Also as to the value of the Winter Nelis.

Mr. Lane thought the Louise much the best on the quince, worth double the same variety on the pear. The Winter Nelis he thought unprofitable; indeed he did not advise the growing of winter pears in this state, though some of the late fall or early winter sorts were desirable and succeeded with him.

Mr. Wheelock had found the Winter Nelis to succeed, and spoke well of it. He endorsed pear growing in Vermont as a success, and approved of Mr. Lane's method, as given in his paper.

Dr. Hoskins, of Newport, inquired in reference to the quince stock for pears. He said he was aware that the quince itself was too tender for successful culture in any part of the State, with perhaps slight exceptions. It is certainly much more tender under extremes of climate than the

pear, but used as a stock, entirely under ground, he wished to know whether it showed tenderness. He asked this for a particular reason, because it was claimed, in apple culture, that roots hardier than the stock were desirable as a means of long life to the tree. All his own experience and observation went the other way, showing that the roots always suffer less than the tops, and where winter killing takes place that the roots survive when the tops are destroyed. Now, if the quince, as a stock, lives and does well where the quince itself is winter killed, a strong support would be given to his view of the matter, and a refutation given to the assumed necessity of crab stocks for apples.

Mr. Lane replied that he found the quince perfectly hardy when kept below the surface, although the quince itself was not hardy on his place. There are other reasons for setting pears on the quince so as to entirely cover the quince stock. One is that the pear will in time throw out roots of its own; and another that the borer, which does not attack the pear, is very destructive to the quince. He never had a tree die at the roots from the effects of the climate. His pear crop averages one hundred bushels a year, and if he had limited himself to two or three varieties it would be double. He mentioned the Beurre Diel as a good late fall variety.

Mr. Heath asked for experience in regard to pear culture in Washington County.

Dr. J. S. Spaulding, of Barre, who was called up to answer this question, said he had planted only two pear trees and lost them both, but was going to try again. Others in his town had, however, done better, and he believed that success was attainable where proper sorts were planted and the right kind of care given. Dr. S. gave his experience in

apple growing. Had been quite successful. He dug only small holes, just sufficient to extend the roots; mulched with straw; kept down weeds; did not water his young trees.

In the fall puts a few shovelfuls of stable manure around the trees, which he scatters about in the spring, adding a little superphosphate. Prunes in haying time, not only fruit trees but ornamental trees also; thinks they heal best when pruned at that time. He used guano and superphosphates wholly, for manure.

# THE PRODUCTION OF GRASS FOR HAY.
## IMPORTANCE AND VALUE OF THE CROP.

A PAPER READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, AT ST. ALBANS, MARCH 7, 1872,

BY E. R. TOWLE. ESQ., OF WEST BERKSHIRE,
Agricultural Editor, St. Albans Messenger.

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We may consider grass and its product of hay the most important crop in Franklin County. As we take note of the large quantities of butter and cheese, of cattle, horses, sheep and swine, annually shipped from this part of the State, we shall have some idea of the great amount of forage necessary to supply the stock, of which these yearly sales are the products.

Of the amount of hay produced in this county we have no very definite idea. We heard it stated not long since, that 1,000,000 tons were annually produced in this State, and about the same amount of grass in pasturage. Of this, at least 80,000, perhaps 100,000 tons, worth $1,000,000, at least, must be produced in this county. Taking into consideration the importance and value of the hay crop, farmers should be, and are anxious to ascertain, not only how they may keep up the present yield of their meadows, but to increase this from year to year.

The increased production of grass and hay will necessitate the keeping of more stock, the manufacture of larger quantities of butter and cheese, and what is of equal importance, of a greater amount of manure, the proper appli-

cation of which will still further increase the production of our meadows, and we are then at once on the road long sought for, that will lead us onward in the path of progress and improvement.

### THE USUAL METHODS OF PRODUCING GRASS FOR HAY.

The methods usually practiced by farmers for laying down fields to grass, is to plant corn or potatoes with manure, one year, and seed to grass with sowed grain crops the next. Sometimes oats are sown two years in succession, seeding to grass the second, with manure. On good grain land the first is the most usually practiced, and perhaps with best results, for the reason that the cultivation and manure necessary to secure a satisfactory crop, fits the land admirably to seed down to grass.

Where no hoed crop is included in this rotation, a dressing of manure should be applied and harrowed in, when seeding to grass, as it is poor policy to devote the strength of the manure almost entirely to the benefit of the grain crops. If, as sometimes happens, it is inconvenient or impossible to apply the manure when seeding down to grass, the field should be top-dressed early in autumn, when it will usually produce excellent results. Where grass is the principal object, and a meadow needs re-seeding, if the soil is mellow and free from stones, the sod can be nicely turned over, and immediately seeded to grass, either with or without a grain crop. Where this is practiced, the ground should be thoroughly harrowed, and a coat of fine manure applied. If seeded without grain, it should be done early in autumn, in order to secure as good a growth of grass as possible, before winter sets in. This should be allowed to remain upon the ground, and not by any means fed off. The grass will then act as a mulch, protecting the young roots

from any injurious action by the frost, and secure an early start in spring.

### PREPARATION OF THE SOIL AND SEEDING TO GRASS.

It is quite important that lands to be seeded to grass should be put in as good condition as possible for this purpose. The ground should be thoroughly plowed and harrowed, and this when the soil is sufficiently dry to be easily worked. Wet and heavy soils cannot otherwise be put in a fit condition for any crop, much less for one of which the seeds are so small as the grasses. Stone and other obstructions should be removed previous to seeding. It is not found necessary here to have the land covered with stones, to keep the soil warm, or to prevent it from blowing away. Grass seeds should be covered lightly. The brush or roller is considered sufficient for this purpose.

### QUANTITY AND KINDS OF SEEDS TO SOW.

Timothy, or herdsgrass, as it is usually called, and red clover, are the varieties principally sown here, although of late years several other kinds are being added to these. Where we can get good crops of timothy, no other kind will answer our purpose better for hay, but this is not always the case, especially the first year after seeding; hence the necessity of sowing clover, which will produce one or two good crops, after which it will disappear, and the timothy will then take its place. Clover is considered a good forage plant, and makes a nice quality of hay when properly cured, but this process is more difficult with the clover than with the other grasses. The mechanical effects also on the soil are beneficial, and it furnishes a valuable material to turn under for fertilizing purposes.

A liberal quantity of seed should be sown, as this will be found to greatly improve the quality of the hay. Where

timothy is employed alone, from twelve to sixteen quarts to the acre, according to the nature of the soil, is not too much; some may advocate a larger quantity. When clover is added, a less quantity of the first is required; perhaps from eight to twelve quarts, and from six to ten pounds of the last, may be a fair proportion of each to use. These seeds should be well mixed and sown with care, if by hand, to secure an even distribution. A surer way of doing this is by using the seed-sowing apparatus, attached to "Sunderland's field roller," which scatters the seeds much more evenly than can be done by hand. Grounds should be ready to seed to grass as early in the spring as possible after the soil is in fit condition, in order to secure a good germination and growth before the dry weather sets in. A moderately wet season is more favorable to a good "catch" of grass than a dry one. Wheat and barley are better crops to seed to grass with than oats, for the reason that the straw of these kinds of grain does not stand so thickly on the ground as that of oats, and perhaps is harvested a little earlier, especially barley. When seeding with oats, too great a quantity of the latter should not be sown, if a good "catch" of grass is expected or desired.

### SEEDING TO GRASS WITHOUT A GRAIN CROP.

This is practiced to some extent in this county with good success, the increased production of hay being considered of more value than the grain crop. The President of the Westminster Farmers' Club, name not known, having a piece of ground which he feared might be too wet to seed in spring, sowed with timothy in the fall, and with clover the next spring, and that season cut two heavy crops of grass. There may be a very important advantage in seeding in the fall, when in good condition, such lands as may

be so wet, until quite late in the spring, as to render a good catch uncertain, even if not impossible.

### OTHER VARIETIES OF GRASSES.

Several other varieties of grasses are being sown to some extent, improving the quality of the hay, and being more especially adapted to different soils and locations. Among these kinds we will mention "Red Top," "Fowl Meadow," "Alsike or Swedish Clover," and "Orchard Grass." The first of these has been used for years, to a limited extent, the others for shorter periods.

Red Top is more especially adapted to moist land, where the clovers would not succeed. When cut in season, this grass makes a good quality of hay. The seed is light and chaffy, and requires considerable care and dexterity in sowing. This may be sown with timothy, as it matures about the same time.

Fowl Meadow is adapted to wet and alluvial soils, but we are not acquainted with its merits as a forage plant, and can therefore give no definite description of it as such, or of its value. We hope that some others present can and will do so, if it is worthy of extended notice and cultivation.

It is only a few years since the Alsike clover has been employed as a forage plant in this country. In size and appearance it is about half way between the red and white clovers. The blossoms are of a medium size, white in color, tinged with red, the stalk slender and not very tall. It is later than the red clover, and from this cause better adapted to sow with timothy. The seeds are so minute that a small quantity in bulk, only, is necessary to sow with timothy, three or four pounds being sufficient. The Journal "How to Make the Farm Pay" says that three quarts of each is enough for an acre. We should prefer to add red clover

also. The above Journal represents this clover as a great addition to our forage plants. We copy the following extract, to show the value that is set upon it in Pennsylvania: "We believe, upon a fair trial, Alsike clover will recommend itself favorably to the farmer, and will be preferred to the red, whenever it can be advantageously grown. This year (1871) it has been cut six feet four inches in length, and the average length on one acre was four feet. Our stock prefer it to all other clovers, and the aftermath does not salivate our horses or cattle. It should be sown with timothy or stiff grasses, to hold its fine growth up. It will stay green until after harvest, when it will be as green as the timothy, and not turn black, as our red clover when cut late as timothy is. Alsike luxuriates in damp soils, and will not freeze out as the red clover, and can also be used well as a fertilizer, as it yields a heavy, succulent mass to plow under. It has also three times the amount of roots that the red clover has." We have not found the upward growth at all to compare with that as given above, but a longer trial may exhibit it in a more favorable light in this direction. But we think a smaller growth would be preferable, and make a better quality of hay. We would advise farmers to give it a trial. It is a honey-producing plant, and would be of value to bee-keepers.

Orchard grass is grown to some extent in this country, but not much if any in Vermont. It is described as a perennial plant, and one of the most vigorous and hardy of grasses. A. W. Cheever, of Sheldonville, Mass., who has considerable experience with it, says it is not injured like timothy or red clover by close mowing, or cutting in hot dry weather, and he has found no grass equal to it to withstand the drought. One of its greatest merits is its liability to produce several crops in a season, and the richer and deeper

the soil, if not too wet, the greater the growth, and the oftener it can be cut. He has raised it for six years, commencing with one fourth of an acre. He mowed from that piece of ground *fifteen* crops in five years, without top-dressing. Now he has four acres of this grass, and thinks very much of it.

Hon. Harris Loomis, of Herkimer County, N. Y., stated, at the meeting of the Vermont Dairymen's Association in 1871, that he had obtained three cuttings of this grass, two feet high, in a season. He recommended it very highly, should sow two bushels of seed—it is very light—to the acre, on rich, well-prepared ground, without any grain crop. Farmers would do well to give orchard grass a trial, as it must make a first rate soiling crop.

### TOP-DRESSING GRASS LANDS.

The grass crop can be greatly improved on most of our meadows by top-dressing with manure and special fertilizers, such as plaster, superphosphate, &c. To produce the best results there should be a good smooth sward, and the land not too dry, to receive the most benefit from the application of barn-yard manure. If a little moist it will be found to work well, hence fields that are not sufficiently dry to plow, will be found to produce good crops of hay, with occasional top-dressings of manure. Those farmers having deposits of muck available for use, will find that they have a most excellent material to compost with the manure from the yards and stables, for their grass lands. With a good supply of muck at hand, they can double their usual quantity of manure for this purpose, at a small cost, compared with its value.

### THE TIME TO TOP-DRESS.

It is generally conceded that the best time to top-dress grass lands is as soon as may be after the hay crop is taken off, or

early in autumn. It should be done previous to the fall rains, so that the fertilizing portions of the manure may be carried down to the roots of the plants, where they will be readily absorbed by them, causing a rich growth of vegetable matter that will afford an excellent protection for the roots of the grasses during the season of winter, and also in their decay add to the amount of fertilizing matter on the ground. The manure should be finely and evenly spread, so as to cover the entire surface, so far as possible. This we have found from experience can best be done directly from the cart or wagon. If the manure is lumpy, it should be gone over with hoes, an inverted harrow or bush, and made fine. This is very important, as hard dry lumps are of little value as a fertilizer, and besides are in the way.

We presume that coarse, green manure may be used with advantage on grass lands, but we should prefer to have it well rotted and fine. In this state it is more easily and evenly spread, and in a better condition for immediate use by plants. Sometimes it is found beneficial to sow on grass seed and harrow in with manure ; also to roll grass lands in spring. We have found, by calculation, that a load of fine manure, of thirty bushels, is worth two dollars, and produces that amount of hay. From this it will be seen that a farmer cannot better employ a portion of his time than in making and saving as large a quantity of this indispensable article to good husbandry as possible.

## SPECIAL FERTILIZERS.

Gypsum or plaster can be used to much advantage on some soils, and where it works well it is a very cheap fertilizer. It is particularly adapted to sandy and gravelly soils, and produces excellent results on clover. It also acts well with manure, when applied to grass lands. From one to

one and a half bushels per acre are sufficient. It should be sown early in the spring, and in damp weather, or just previous to a rain. We wish the Secretary would tell us to what the action of plaster is due—whether it possesses any fertilizing properties of its own, or whether it unites with certain elements in the soil and thus renders them available for the use and benefit of plants. This matter is not understood much by farmers, if indeed it is by scientific men.

Some have an idea that the continued use of plaster will tend to decrease rather than increase the fertility of those lands to which it is applied. If an increased production of crops can be obtained by the use of plaster, and these crops are fed out on the farm, the extra amount of manure made certainly should be sufficient to keep these lands improving, rather than otherwise.

Some have used plaster to no purpose, while others have found it to produce excellent results. Perhaps something of this variation is due to season, a little to the quality of the plaster, and more to the nature of the soil to which it is applied. A farmer in the town of Franklin sowed plaster in 1870 upon a piece of high, dry meadow, of a gravelly soil. The year previous this field had produced only two loads of hay, composed principally of ox-eye daisy. He sowed at the rate of 150 pounds to the acre. The next haying season he obtained six loads of nice hay—clover and herdsgrass, while the daisies had disappeared. In 1871, the yield had decreased one third. This farmer also applied it the same season to a dry hill pasture, with marked benefit. This is only one instance, and we presume there are farmers here who can relate an experience equally good. Some have used superphosphates on grass lands with good success. Where this works well, it makes a valuable fertilizer for this purpose. But it will not act alike on all soils,

and trial and discrimination are necessary in its use. A gentleman living in Montreal, who has a farm just the other side of the line, north of this county, had a meadow that had been in grass for some fifteen years, and had not been manured or re-seeded, and at this time produced only a ton of hay to the acre. He sowed on this field a barrel of superphosphate to the acre, and the yield was increased the first season to one and a half tons per acre; the next year it was the same. The third year he sowed plaster thereon, and the same result was continued. If these results could be obtained by others, it would be found to pay exceedingly well.

### FEEDING MEADOWS.

It is claimed by some that if meadows are not fed, spring or fall, they will continue to produce good crops of hay without manure. On some meadows, as intervals or those annually overflowed, this may be the case. We find in the report of the Connecticut Board of Agriculture, for 1868, that some farmers near the Hudson River, in New York, for the last twenty years have sold nearly all their hay, keeping up the production of their meadows by allowing the entire second crop to decay on the ground and become a fertilizer for succeeding crops. It is not to be expected that such results as these can be very generally obtained, but it may readily be inferred that if we would not feed our meadows in the fall, unless there was a very rank growth, and then not to any great extent, and none at all in the spring, we should see a very plain difference in the yield of our hay crop.

Some of our meadows are too wet for the successful production of grass for hay; the crop is inferior both in quantity and quality. These meadows cannot be top dressed

with manure to advantage, and to make them profitable they should be drained, and then, perhaps, plowed, manured and re-seeded. Such a course as this must, and eventually will, be pursued with these lands, for here the soil will undergo a change, as also its productions, and they will become the most valuable portions of our farms.

We might bring forward instances of successful farming in this county where men have commenced on poor farms and have increased the production of their lands until their hay crop has been doubled and trebled in amount, and increased in value. This has been accomplished by persistent labor, directed by skill and intelligence. The leading idea has been to increase the amount of manure, and with the proper application of this, the crops have been increased in proportion.

We see before us many successful farmers. Their labors have been well rewarded, and they can, if they choose, to-day, give us facts and results from their experience that will be of much interest and profit to all. One object of these papers, of these meetings we may say, is to bring out experience; to get at results most valuable in themselves, but which might otherwise fail of accomplishing that wide-spread good which might be expected if known and appreciated by all. Brother farmers, let your light shine. Be not afraid to contribute those items of experience, the results, perhaps, of many years' study and labor, that will so materially assist others who are going over the same ground where you have been, and are uncertain as to what the end will be. "To do good and to communicate" is a very wise maxim, and worthy to be heeded and followed by all. You may not be able or willing to endorse all the ideas advanced in this paper; that is hardly to be expected; but you may be

able to show a "better way," and in so doing advance the common interests of our occupation, which Washington declared the "most healthful, most useful and most noble employment of man."

# GRASS CULTURE.

A PAPER READ BEFORE THE LATE MEETING OF THE BOARD OF AGRICULTURE AT MONTPELIER.

BY S. P. JOSLYN, ESQ., OF WAITSFIELD.

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I am invited to open the discussion on "Grass Culture," by reading a paper. The subject is of such moment, the invitation should have been given to one having some requisite qualification for doing justice to it. I can only refer briefly to some facts, perhaps of common experience, and leave it for those who follow in the discussion to speak in detail.

The Vermont farmer, living so far from large cities and seaport towns as to preclude market gardening, must necessarily ever make grazing, in some of its forms, his principal and chief reliance. The cereal grains can be laid down at his door, from the great granary of the West, at too low a rate for him to raise them to sell.

The grasses form the basis of food for most of our domesticated animals. Their culture, then—how we can best increase the amount and value of the crop—is a subject of almost vital importance; should be held in the highest estimation, and reckoned second to none else by the Vermont farmer.

From me you did not expect a scientific view of this subject, nor facts in relation to other localities. Neither did you expect I had tampered with Lucern or Alsike clover.

As it is, I trust you desire such facts as are available by, and come within the reach of all, and not what some retired capitalist or fancy farmer accomplished, by spending four dollars to one returned. But let the farmer, who tills his acres to remove a mortgage that became necessary in the purchase of his farm, never listen to the almost obsolete jeer against book farming. Let him rather adopt that progressive kind which arises from all the knowledge one can get from books, from agricultural periodicals, from such associations as this Board, and every other source of information. If he discard office so far as to buy out of it, instead of into it, it will be all the better for him. If he stands at the head of well selected laborers, and does as much work as any of them, they will need no other stimulus. Next, make the cultivation of the grasses a speciality. Instead of cultivating to see how many bushels of corn or other grain he can raise to the acre, let that be a secondary, and the after-grass a paramount consideration. Soils differ so materially, often in close proximity to each other, that the same treatment will not answer for both. Hence the conflicting views in relation to deep and shallow plowing, surface manuring, and plowing in manure. I believe that farmers, as a class, are noted for great conscientiousness in relation to the usury law, and would have the legal rate at six per cent. That being so, it would be wise in them to make greater effort to bring their acres up to a standard, and not be content to take a much less rate. If one acre only can at first be brought to the right standard, it is commencing in the right direction. That acre will help largely to fit out other acres. The ball will increase every time it is turned over. Ask the advocate of shallow plowing if a deep soil is not better than a shallow one, and how will he obtain it without deep plowing and manuring ?

Our recent frequent droughts, arising from a general destruction of the forests or other causes, render deep cultivation of the utmost importance to the grass crop. With it, and liberal manuring, a good grass crop may be obtained on most soils, even in seasons of great drought. The man who insists on shallow cultivation must, just so long, follow the skinning system. One writer, who believes in surface manuring, asks us to be instructed by nature, in the large forest growth produced by an annual top-dressing of leaves. Surely, and does not that dense forest shield from the sun's rays and keep the top-dressing moist and pliable? Whereas we want the solar rays about the roots of plants, and a little artificial covering to keep the necessary dressing from being parched up by them. I have used for some fifteen years, on a farm located on a spur of the Green Mountain range, with a westerly slope and loam soil, neither sandy nor clayey, one of Nourse & Mason's double-swivel plows. It does not turn a flat furrow-slice, but thinly skins the sward, then flings up loose earth, leaving an uneven surface, which facilitates commingling of the manure with the soil. I spread a coat of manure on the sward, and then the work of this plow, from the depth of from ten to eleven inches, does something towards mixing it with the soil, instead of planting it all below a flat furrow-slice. Spread on another coat of manure, and the harrow, with the uneven surface, readily covers it, and it is fitted for a crop. Never take off but two crops while under the plow. Seed with the first or second, using one half bushel of timothy seed to the acre, one's own raising. If highly manured, on such land as I have described, no clover need be added. Enough will be found in the crop. Thus treated, ground will produce a good crop of hay from eight to ten years without plowing. I have plowed thus and

spread all the manure on the top, seeding down the first year, and obtained a good crop of grass, but it will not hoid out nearly as long. Avoid too close or too early cropping of the aftermath. By all means avoid over-stocking, summer or winter. It is a great bane to the farmer. Early cut hay, well secured, will keep well for years. It is sure to be wanted. Do not be afraid of summering over a few tons of hay. It will not bankrupt a live farmer. It will make an independent man of him in a season of short crop. The shallow cultivators will swarm about him like bees at such a time, if he has any feed for their starving animals. I have succeeded well with top-dressing. I have applied it in early spring and fall. It should be applied before the crop has much diminished. The quality of manure and time of application are of some moment, but to be sure that it is applied is of greater.

Question: Where do you get your mannre? I have had nothing to do with commercial fertilizers. They may pay on some soils and in some localities; but the best fertilizer is the brain, in securing all that can be made available on the farm for home manufacture of fertilizers. For a rule, feed out all produce of the farm on the farm, if it does not bring quite so much ready money. Keep a dairy; keep the swine at work; yard the cows, or with proper fixtures stable them, and let them have extra feed. What then will become of the pasture? Make up its deficiency by turning refuse mowing into pasture, and by entering partially into the soiling system. It is thus chiefly that I have succeeded in making two or three spears of grass to grow where but one grew before, having raised two hundred and fifty ox-cart loads in a single year. It may be just to add that I was stimulated more by the expectation of benefiting myself than of becoming a benefactor to my race.

I desire again to urge a more general attention to the cultivation of the grasses. Because they are perennial plants and do not need renewing every spring, and grow spontaneously, they have been left to do so. A more general attention to this branch of Vermont husbandry is necessary. That it is in this that the wealth of a farmer chiefly lies no one can deny. A sufficiently mixed husbandry is compatible with it. It will not conflict with his raising his own wheat and other grains. I have done so myself for the last thirty-four years, with the exception of but one year.

In the discussion following Mr. Joslyn's paper, Mr. Jameson spoke of the value of irrigation, wherever it is practicable, for the improvement of the grass crop. He instanced its successful application upon Dea. Chandler's farm in Northfield, where the owner considered the benefit of a small brook in irrigating a field fully equal to $500 at interest. It is also practiced upon the Doe farm in Hardwick, and on another in Albany. In Lombardy, Italy, one million acres out of the six millions in cultivation were irrigated, and eight crops of grass were cut annually. The seasons there are longer than in Vermont, but great results might be obtained here by its practice. All the things recommended by Mr. Joslyn are excellent, but wherever it is possible irrigation should be tried also. Where grass land is irrigated it needed neither manure nor tillage to keep up its productiveness, and its crops may be used to increase the manure pile for application to other portions of the farm.

Mr. Bisbee believed the grass crop to be the key to success. Mr. Joslyn, who is my neighbor, gives his main attention to grass and makes it pay. Corn does not pay, as a rule; wheat may do so if it eseapes insects and rust. Grass

is our main reliance. He found plowing and restocking very successful in renewing old pastures. Top dressing on mowing had not succeeded so well.

Mr. Eldridge. All farms are not like Mr. Joslyn's. Some land is too moist to plow, and there are many dry knolls. Had tried irrigation some, and mowed the piece twelve years, having heavy grass; it got into willows and coarse grass at last. In moist land he had turned over the sod, manured, and seeded without grain very successfully. He spoke of clover as an important crop.

Mr. Perrin did not like too much clover in his grass.

Mr. Wheelock advocated seeding in the spring without grain; also after grain in the fall. Turnips are good, sown with grass seed in the fall, to prevent winter killing.

Mr. Joslyn had practiced seeding in the fall without grain. It does well on level ground, but on hill sides will not hold the soil so as to prevent washing. Advised light top dressing, applied before the grass begins to fail.

Mr. Eldridge objected to sowing *much* grain in seeding down, also to cutting the grain too close. The stubble is valuable as a protection.

Mr. Joslyn. Lodged grain kills the young grass. For that reason he thought two bushels of wheat to the acre too much. A bushel and a peck is about right, and gave him twenty-eight bushels yield last year. Uses but little oats in stocking, mostly wheat.

A speaker, whose name we did not catch, said the farmers in Waitsfield were very successful in fall seeding, done early. Seeding on reversed sod succeeds well also. Found that grass seed without grain does best—holds out best. Seeding late in the fall, too late for the seed to sprout, was also a good

way; the grass gets an earlier start, so as to get a good crop the first season. On wet land this is altogether the best plan.

Prof. Collier spoke of the success of underdraining on the grass lands of the Mohawk Valley. He gave an account of Hon. Harris Lewis' experiments with orchard grass, on underdrained land, getting four crops a year. The grass crop of Vermont was and must be for years the most important one, and he advocated improvement in its culture. In reply to an inquiry for some thoroughly reliable book on farming, Mr. Collier spoke in high terms in favor of "How Crops Grow," and "How Crops Feed," by Prof. Johnson of New Haven. He thought them the most reliable and best works extant.

Capt. O. C. Wilder, of Waitsfield, spoke in favor of cultivating in manure, following with the harrow, before seeding to grass. It gives the grass a better start.

Dr. Spaulding referred to an instance of heavy crops of clover in Montpelier—five tons to the acre, in two cuttings—done by heavy manuring. Another piece of herdsgrass was mowed six times, making a growth of thirty-six inches from May 24 to June 24, and an aggregate of 108 inches during the season.

Mr. Jameson, of the State Board, has already collected over fifty specimeas of grasses native to Vermont, and will complete the work of collecting and arranging for the museum.

# THE BUTTER DAIRY.

AN ESSAY READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE,

BY D. B. WHEELOCK, ESQ., OF BARRE.

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After a brief introduction Mr. Wheelock said:

Perhaps, to show the great importance of Butter Dairying to the farmers of Vermont, a few facts and statistics will not be amiss. I have not been able to obtain the statistics for 1870, therefore the estimate for that year is based upon the same ratio of increase as from 1850 to 1860. In 1850 the amount of butter made in the State was 12,137,980 pounds; in 1860, 15,900,359 pounds; increase 31 per cent., and at the same rate of increase in 1870 the amount would be 20,829,470 pounds, which, if sold on an average of 30 cents per pound, would amount to $6,943,153, a sum exceeding the total value of all the corn, wheat and rye raised in the State in 1866. The amount of butter made in 1860 exceeded by more than 4,000,000 lbs. that of any other of the New England States, Maine approaching the nearest, making 11,687,781 pounds. Not only in butter, but in cheese, Vermont also leads the other New England States, having made in 1860, 8,215,030 pounds, while Massachusetts, which is second on the list, made in 1860 only 5,294,090 pounds. In the matter of cheese there was a slight decrease in the amount made from 1850 to 1860 of about 6 per cent.

Vermont in 1866 had 162,356 cows, valued at $8,812,684, while Maine had only 129,891, valued at $7,310,265, and Massachusetts had 127,415, valued at $7,899,730. It will be seen that our rough Green Mountain State exceeds that of either of the other New England States in the value of her butter and cheese, as well as in the number and value of her dairy stock. A record surely of which we need not be ashamed.

Butter has now become an important article of export. Over 6,000,000 pounds were exported the past year, and it is said that by opening the ports of Japan, a market will thus be found that will take all the butter and cheese we have to spare; at any rate we need have no fear of an over stock of really good butter. The only butter that is ever a drug in the market is of that quality which none of us wish to own.

There are several essential elements necessary to the making of good butter. Good cows, good feed, good salt, a good churn, and a good woman; and it is said by some that the possession of the last would insure the first four. There are certainly three things that are important to a successful butter dairy. 1st, good cows; 2d, good feed; and 3d, a good process of making butter. First, there are good and poor cows among all breeds of cattle; hence, it is not a safe theory or practice to adopt any one breed thinking thereby that we are on the high road to a successful dairy business. The various breeds have their advocates, claiming their particular breed as superior to all others, but the circumstances and conditions existing with the different farmers make uniformity of breed not desirable or profitable. Yet there are certain facts, that have been established by science and repeated trials, that will be well for us to heed in the selection of cows for a butter dairy. It is of

vital importance that for such a dairy cows should be selected or kept that give milk that is rich in cream, and the only sure way to ascertain that fact is by setting the milk by itself, thus knowing for a certainty of the value of the cow for butter purposes. To aid us in this matter, many and repeated trials and experiments have been made, both to test the value of different breeds for butter purposes, and to test the effect of different kinds of feed for the same purpose.

The following experiments were made in England a few years since for this purpose :

*Experiment No.* 1.—Feed, grass and hay only.

| | | | | |
|---|---|---|---|---|
| Pure Brittany | cow's milk, | 19.27 | per cent. | cream. |
| Pure Jersey | " | 18.65 | " | " |
| Pure Durham | " | 15.32 | " | " |
| Pure Ayrshire | " | 13.47 | " | " |
| Pure Devon | " | 14.87 | " | " |
| Cross between Jersey & Durham, | " | 17.95 | " | " |

*Experiment No.* 2.—Feed, grass, hay, 1 lb. linseed cake.

| | | | | |
|---|---|---|---|---|
| Brittany, | milk, | 20.00 | per cent. | cream. |
| Jersey, | " | 18.98 | " | " |
| Durham, | " | 16.02 | " | " |
| Ayrshire, | " | 14.14 | " | " |
| Devon, | " | 15.31 | " | " |
| Cross breed, | " | 18.21 | " | " |

*Experiment No.* 3.—Feed, grass, hay, brewer's grain and one measure condiment.

| | | | | |
|---|---|---|---|---|
| Brittany, | milk, | 20.70 | per cent. | cream. |
| Jersey, | " | 18.62 | " | " |
| Durham, | " | 16.09 | " | " |
| Ayrshire, | " | 14.09 | " | " |
| Devon, | " | 16.07 | " | " |
| Cross breed, | " | 18.84 | " | " |

*Experiment No.* 4.—Feed, grass, hay, meal and feed extra.

| | | | | |
|---|---|---|---|---|
| Brittany, | milk, | 22.00 | per cent. | cream. |
| Jersey, | " | 20.00 | " | " |
| Durham, | " | 17.95 | " | " |
| Ayrshire, | " | 13.94 | " | " |
| Devon, | " | 16.09 | " | " |
| Cross breed, | " | 19.05 | " | " |

*Experiment No.* 5.—Same feed, but changed in proportion.

| | | | | |
|---|---|---|---|---|
| Brittany, | milk, | 21.50 | per cent. | cream. |
| Jersey, | " | 19.08 | " | " |
| Durham, | " | 18.56 | " | " |
| Ayrshire, | " | 14.84 | " | " |
| Devon, | " | 17.00 | " | " |
| Cross breed, | " | 18.60 | " | " |

It will be seen by these several trials that the Brittany cow exceeded all others in the richness of milk, being on an average over one-fifth cream, but her size precludes all thoughts of her as a dairy cow. Her weight at five years old rarely exceeds 500 pounds, but the old adage, with little variation, might be said of her, "great cry and little wool," to "great yield and little food." The next on the list in richness of milk is the Jersey, showing almost one-fifth of her milk to be cream. If butter alone was the only profit of a butter dairy, then, surely, she would demand our serious considerations. As a breed, the Jersey stands preeminently at the head when the quantity and quality of milk is considered. It is not an uncommon occurrence for a good Jersey cow to give milk from which 12, 15 or 18 pounds of butter is made per week. The celebrated Jersey cow "Flora," imported and owned by Mr. Motley, of Massachusetts, produced more than 500 pounds of butter in one year. Less than five quarts of her milk would yield a pound of butter. The Jersey "Lady Milton," owned by Mr. Converse

of Massachusetts, gave in the months of June, July and August in 1868, 1595 quarts of milk, from which was made a fraction over 249 pounds of butter. Also the Jersey cow "Cream Pot," owned by Mr. Flagler of Massachusetts, gave in the same time 1533 quarts of milk, which produced 239½ pounds of butter. Many other cases might be stated of similar results, showing conclusively that the Jersey is pre-eminently a butter cow. But the scarcity of the breed in its pure blood, makes it impossible for it at the present to take the place of other breeds in our dairy stock. The whole number of pure Jersey cows in the United States in the spring of 1869 was only a little more than 1000. Of that number Massachusetts had 293; New York 202; while Vermont had only five. Therefore, however desirable it may be to obtain the pure Jersey cow, we must be content to cross it with our other good breeds. It is shown by the experiments alluded to, that the cross made by the Jersey and Durham breeds comes next on the list as to richness of milk; and when we consider the fact that only about one third or one-half of the heifers raised make good cows, it is of some importance that in turning them for beef they are of good size and easily fattened. The cross with the Durham then is desirable—that breed being one of the best, if not the best, for that purpose, and also as a breed they are next to the Jersey in the richness of their milk. In the trial alluded to, the Devon was 4th and the Ayrshire 5th, or last, as to quality of milk. In this trial nothing is said as to quantity. Had that been the test, I have no doubt but the "last would have been the first," as the Ayrshire is famous for a large yield of milk.

I am well aware that few farmers have the means to test the quality of their milk in this manner, and I fear some come to the conclusion that scientific dairy farming is a

theory designed for those who have plenty of money to spend. But facts are stubborn things, and reason as much as we please against them, they are nevertheless true, and the same circumstances will produce the same results.

Having decided as to the dairy stock, whatever the breed, the next in importance is the feed. It is of but little importance to purchase extra good cows with the expectation to profit in the butter dairy, unless we are prepared to feed well. The farmers who undertake to keep cows and neither feed them well or house them well, will find that whether they have Jerseys, Durham, native or grades, they have a lot of poor cows. Said a writer upon this subject: "A man that will starve or abuse such a mild, beautiful, forbearing and *Christian* animal as the cow, is fit only for the loneliness of the desert."

It is simply absurd to expect a cow, however good, to yield large quantities or rich quality of milk unless she has sufficient and suitable food for that purpose. She is simply a machine, taking her food and, after supplying the wants and wastes of the body, manufacturing the surplus into milk.

You might as well expect the woolen manufacturer to make a superior article of cloth from coarse shoddy, as to expect the cow to give a superior quality of milk when fed on coarse and improper food. Grass is the best and most natural feed they can have for producing milk. So long as the feed in the pasture remains good they need no other, but when that becomes short, and our pastures dry, then some other green feed should be given in order to keep up the full flow of milk. Corn fodder is perhaps grown for that purpose more than any other feed. Some contend, (and Dr. Loring among the number,) that it is of but very little value, but until we find some other substitute for the green grass, it should be grown and fed to a greater extent than

now. It should be cut at least twenty-four hours before feeding in order to have it well wilted; should be fed at night in the barn after milking, and if pastures are very short in feed, cows should be fed also in the morning. Our pastures should also be well supplied with abundance of pure water at all times. Experiments that have been tried show beyond a doubt that the milk of cows drinking stagnant (and of course unwholesome) water for any length of time, becomes so much affected as to be unfit for making good butter. Hence the importance not only of good feed but water also. The farmers of this county have not much reason to complain of the quality of the summer feed. Some of them may have too much stock for their pasture; if so, see to it that your dairy stock is not short in this respect, as on that depends in a great degree the profits of your dairy.

One of the most difficult things the dairy farmer has to do, is to keep up the flow of milk from his cows after they come to the barn in the fall. Here is where many dairymen fail. In our cold Vermont winters the cow not only wants nutritious food, but a warm, well ventilated stable also. Various theories and practices are advocated, but we should in this matter, which is so important to the dairyman, try and learn from the experiments of others, unless we are willing to try them ourselves. It has been demonstrated over and over again that, if we would keep up the flow of milk from our cows in winter, it must be done by extra care and feed. The best and cheapest manner for so doing by those who have large numbers—say from fifteen upwards—is by steaming all, or nearly all food, and adding a little fine feed or meal thereto. Accounts that have been accurately kept show that a saving of from twenty to thirty per cent. is thus made. A Prindle steamer, with all necessary pipes, &c., set ready for use, would cost only from $65 to $75. To those

who have only a small dairy a great saving can be made, simply by cutting the feed and mixing in, say two quarts, of bran or fine feed for each cow; then put all into a water-tight feed box, and wetting thoroughly with hot water, put on a cover, and let it stand several hours; say mix in the forenoon for night feed, and at night for morning feed, giving a little dry hay at noon; wheat, oats or rye straw thus cut and wet, will all be eaten with as good relish as the best of hay. Another important article of feed for milch cows is roots, which every dairyman should raise. Beets should be raised in large quantities; they are not only relished by the cows, but in the absence of all green fodder they almost seem to be a necessity. I am aware that in all this there is some labor and care, but I am fully convinced that it will pay both in quantity of milk and saving of fodder. Much of our straw and coarse fodder is lost, unless cut, and either steamed or wet in a feed-box as before stated.

To test the relative value of different kinds of feed as compared to good hay, experiments, and close and careful comparison of the results of many trials, have been made with the following results:

100 pounds of good hay are equal to

| | | |
|---|---|---|
| 275 | pounds of | Corn fodder. |
| 442 | " | Rye straw. |
| 390 | " | Wheat straw. |
| 184 | " | Oat straw. |
| 153 | " | Pea straw. |
| 201 | " | Potatoes, raw. |
| 175 | " | " boiled. |
| 339 | " | Mangel wurtzel. |
| 504 | " | Turnips. |
| 54 | " | Rye. |
| 46 | " | Wheat. |

| | | |
|---|---|---|
| 59 | pounds of | Oats. |
| 45 | " | Peas or Beans. |
| 64 | " | Buckwheat. |
| 57 | " | Corn. |
| 105 | " | Wheat Bran. |
| 109 | " | Rye. |
| 167 | " | Wheat, Pea or Oat chaff. |
| 179 | " | Rye or Barley chaff. |

It will be seen by this table that all the various kinds of fodder have a value as a feed for our stock, and by mixing and cooking, that value is increased; but on what principle, I leave for science to explain, excepting that by softening they become more like grass.

I have said more upon this matter of feed than I intended, but I feel that it is a matter too much overlooked by our dairy farmers.

Now last, but not least, is making of the butter; this is a matter in which all seem to be of one opinion, and that is the importance of making really a nice article. Were I to put the question to each individual butter maker, if they make good butter, all, or nearly so, would answer in the affirmative. Nevertheless, there are large quantities of poor butter in market, fit only for the bakers' use, which can, as a general thing, be bought for about the price of good lard. This should not be so; and the question arises where is it all made? and is its quality owing to the process of manufacture? While I have no doubt that much of it has become poor by exposures and conditions beyond the control of the makers, yet I fear much of the fault lies with the manufacturer. I have no doubt that the loss to the farmers of Vermont by poor butter the past year would amount to more than $100,000. Had all the butter made in the State the past year been sold for two cents per pound

in advance of the prices at which it was sold, it would have amounted to over $400,000, a sum almost sufficient to have paid the entire State tax. Now the State ought not thus to lose so much of its productive industry,—and certainly the farmers cannot afford it. This state of things ought not to exist. The remedy is with the dairy farmers; all that is necessary is to make the products of our dairy of that quality that shall command the highest price in the market. In order to make this matter of butter-making a success, we must be in earnest about it; whether we make much or little, let it be good; let us begin with neatness at the barn, having our stables, yards, and in fact everything connected with our dairy, a perfect pattern of cleanliness. In milking see that all is neat and clean. No dairy woman, however neat, can make good butter from milk that is impregnated with the smell of the stable. Some men are careless in this matter, and find fault with the dairy-woman if the butter is not all as it should be, while, perhaps, it is their own fault in matters of cleanliness.

All pans and pails used in the dairy should be made of tin, and kept perfectly sweet and clean by thorough washing, scalding and drying in the sun when possible.

There are different theories and practices among dairymen as to the depth which milk should be set. The milk room should be of as even temperature as possible, say from fifty to sixty. Experiments have been made that show milk will be perfectly creamed at the depth of about three inches; at that depth, with thermometer at fifty, cream will all rise in thirty-six hours; at fifty-five in twenty-four hours; at fifty-eight to sixty in twelve to sixteen hours. Cream should, if possible, be removed from the pan as soon as sour. Put the cream in a tin pail and stir daily, as new cream is added; a little salt also added daily will do no harm; churn in

warm weather at least twice each week; when the cream is churned, the butter should be washed in clear cold water; not washed too much, as that detracts from the fine, sweet butter flavor, so important for a really nice article. After working out what buttermilk you can, salt with at least one ounce to the pound; then let it stand in a cool place twenty-four hours; then work again in butter-worker, using a large sponge and a cloth to absorb all moisture that remains in the butter. Here, I think, is the great secret of making good butter; let it be handled as little as possible with the hands, using the butter-worker and sponge; avoid above all things a grinding or drawing process in working; it is by that process you make your greasy butter. Take the best butter, and unless care be used in working, it will be greatly injured in breaking the grain, and thus you lose that waxy appearance, and it will become greasy, and impossible to make a really nice article. Any dairyman or woman can satisfy themselves on this point, by taking a small quantity of their best butter and working it over by a grinding or drawing process, when they will soon find, instead of its waxy and nutty appearance, it will be changed to a greasy mass, fit only for bakers' use. This practice of using the sponge and dry cloth should be more generally adopted than it is at the present time. This greasy butter forms a large proportion of the poor butter in the market; and from observation, I am fully satisfied that much of it is made in that condition by the manner of working it over. The buttermilk should be all worked out; but this can be done with the sponge and cloth, in the butter-worker.

In salting, use none but the best; either the Ashton or Onondaga; if pure, neither will injure the best butter. As to the amount of salt, that depends much upon the market where it is to go. Some localities will have but one-half

ounce to the pound, while in others one and one-fourth will not be any objection; but as a general rule one ounce will suit the taste of most persons.

The matter of packing is also of importance. Hard wood tubs would be the best; but good spruce tubs, free from any sap-staves, if well made, and well soaked with brine before the butter is put in, will answer, and keep butter sweet through the summer, if kept in a cool, dry cellar. In packing, care should be taken to pack it solid, so that no air can possibly be in the tub; when full, put on the cloth and cover with salt.

Said a writer upon the subject of butter making, "Poor butter is an abomination; to eat it is to degrade the physical, intellectual, and moral nature of man; to furnish it for the table a great wrong; to make it may not be the unpardonable sin, but it is a fault exceedingly difficult to forgive or forget;" while on the other hand good butter is one of the institutions of society, which commends itself to our careful consideration.

Prof. Collier inquired about the proper depth of milk in pans, and spoke of some experiments he had been making in reference to the rising of cream through different depths of milk. He found depth, of itself, not an important element; but it takes longer for all the cream to rise through great depths.

Mr. Wheelock said that at a depth of three inches all the cream could be obtained before the curdling of the milk.

Mr. J. W. Wheelock, of Berlin, spoke of the effects of feed upon the quality of the butter. He said that the belief in Missouri was, that the kind of feed made no difference in the quality of the butter.

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Mr. D. B. Wheelock scouted this idea, and declared that it made all the difference conceivable; that there was no sort of doubt in regard to the effect of feed on the quality of butter. The honeysuckle (white clover) makes the very best butter. Coarse fodder is very injurious, also cabbage and turnips.

Mr. Lane said it was believed that hard wood is the best material for butter tubs; asked Mr. Wheelock's opinion.

Mr. Wheelock replied that he thought oak came first, and then beech.

Mr. Lane observed that an experiment had been tried by a Cornwall farmer, packing butter in spruce, oak and black ash tubs. When examined in the fall it was found that the butter in the spruce tubs had kept best, then oak, and in ash the poorest.

Mr. Clark King, of East Montpelier, spoke in favor of the improved vats for setting milk. With them just as good butter can be made in summer as in winter. They are getting to be regarded more and more as a necessary part of a dairy outfit. Asked if Mr. Wheelock had ever found one who used them to make poor butter?

Mr. Wheelock said it was important to preserve the right temperature in the milk room; thought it a good way to have it partly underground; should be on the north side of the house; it is important to have the *right* and an *even* temperature. Knows nothing about the vats; supposed they were in effect similar to the water tanks for pans or pails.

Hon. John Gregory, of Northfield, spoke of the importance of good salt for the dairy. Thought much butter was injured in flavor from impurities in the salt. Had seen some salt from which the impurities had been entireiy removed.

It was as clear as water, and the substances that had been removed were very filthy. Advised dairy men to be very careful in selecting their salt.

Mr. Wheelock said that the fault with much of the butter in market was not its *bad* taste, but the absence of all *good* taste. This, of course, could not be due to impure salt.

Mr. King said that it was the verdict of dealers in the Boston market that but three tubs out of ten, even of Vermont butter, were first class. He thought there was more in the making than in the salt. Where you get good butter they make it right. Good cows, good pastures, careful milking, proper handling of the milk, are essential to making first rate butter. Milk must not be left too long in the pans—twenty-four hours is too long; skim sooner, churn soon, work properly. Butter must be worked twice, but not too much, and a grinding action of the butter worker must be avoided. Butter is never solid or fine grained when packed with but one working, nor does it keep well. The great mistake made was that the milk was suffered to stand too long before being skimmed. If it stands too long it is impossible to make good butter. Absolute cleanliness was also essential. Fine butter should be worked and then stand before being put into tubs. Don't work it too much. Skim early, churn early, and sell early.

Mr. Z. E. Jameson, of Irasburgh, spoke favorably of the large double pans or vats. They are a perfect success in his neighborhood. In them the milk is quickly brought to the proper temperature and held there. It is desirable that the air of the milk-room should be warmer than the milk. It is not well that the milk-room should be cooler than 70°, and this can only be had when the milk is cooled by water, as it is done with the vats. Then skimming can be delayed

for thirty-six hours without injury. These vats also made much less work for both men and women.

Mr. Leander Coburn, of East Montpelier, inquired, if in cases when water for cooling milk could not be brought into the milk-room, cool air from the ice-house might not be substituted with these pans.

Prof. Collier stated that while cool air might be so used, the capacity of air to absorb heat was much less than that of water, and the expense of using ice-cooled air for that purpose, during a whole season, would be too great. In regard to the rising of cream, Prof. C. said it rose with equal perfection at all depths, provided sufficient time was given, and by the use of tanks time could be allowed for its rising in deep vessels without injury. He spoke also of a recent important discovery of a German chemist, who found that the casein of milk was, to some extent, transformed into butter when the milk was kept from souring for a considerable time. This discovery was perhaps of not much practical value, but was interesting as showing the value of nitrogenous food for butter production.

E. A. Eldridge, Esq., of Warren, (President of the Washington County Agricultural Society,) said that the speakers had not yet given any definite time as the best for milk to set before skimming. He wanted to hear some precise rule for this. Never knew the cream all got up in twenty or twenty-four hours.

I. N. Perrin, of Berlin. In a proper temperature twenty-four hours is enough, and there is no advantage in giving more time. By standing longer, we get a greater measure of cream, but no more butter. The difference is in the buttermilk. Cream raised in twenty-four hours will come in.

three minutes; if it stands longer, we may churn for hours and get bitter butter at last.

Mr. Jameson. With the vats a longer time may be allowed without injury, but the cream must be taken off as soon as the milk begins to curdle. It should not stand over forty-eight hours; thirty-six hours is enough.

Mr. Eldridge thanked Mr. Jameson for this definite information. That is what we want to get at meetings like this, facts that we can take home to our wives.

# ORIGIN OF THE ST. ALBANS BUTTER MARKET.

A PAPER READ BEFORE THE VERMONT BOARD OF AGRICULTURE, AT ITS MEETING AT ST. ALBANS, MARCH 6 AND 7, 1872,

BY DR. R. R. SHERMAN, OF ST. ALBANS.

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In order to bring the subject before you in its proper light, it may be necessary to draw comparisons between the past and the present, or in other words, compare the market as it was up to a certain period, with what it has been since and now is.

Franklin county is composed at present of fourteen small towns, each being about six miles square. St. Albans, although situated on the extreme west side of the county, is the shire town. Fifty years ago the dairy products of the county were but small. The farmers who kept more than eight or ten cows each were then very few, and a dairy of twenty cows was nearly unknown. Butter brought but ten to twelve and cheese four to five cents a pound, and was often a drug in the market at that. Very little of the dairy products of the county found their way to Boston or New York prior to 1840. Up to that time Montreal was almost the only market that the farmers of Northern Vermont could use for the sale of their surplus products, and poor enough it was, too.

Then, during the summer, no butter nor cheese was sold. When the St. Lawrence was frozen the farmers loaded into

their double sleighs their dressed hogs, butter and skim-milk cheese ( which the frost could only mellow and improve ) and started for Montreal. Seldom less than a week was consumed in marketing the load and returning home. Think of it—a week in selling for scarcely $100 what can now be marketed in half a day, bringing from $300 to $400!

About 1840, the tide began to change and farm products began to float the other way. Boston and New York began to seek for them to supply the manufacturing districts that were springing up throughout New England and the Middle States, and as these and other internal improvements advanced, butter and cheese became to be more in demand and at better prices. But they could only be sent to market in the fall, and by water. Buyers then went through the county and bought the butter and cheese to be delivered at St. Albans Bay, which remained the port for the shipment of nearly all the farm products of the county until the completion of the Vermont Central and Vermont and Canada Railroads in 1850.

Then commenced what is commonly called the "St. Albans Butter Market." In one sense such a "Market" has no existence; that is, there is no regularly organized market or exchange, regulated by rules and by-laws, as such markets are elsewhere. Everybody buys that wishes to, and there is nothing to pay for the privilege. Farmers bring their produce here to sell because the buyers are here, and the buyers are here because here are the railroads and the banks.

Previous to the time when refrigerator cars for conveying butter were put on the road, there was not even a "butter day" here. Butter was received and shipped on all days, though more perhaps on Mondays and Tuesdays. But when, in 1854, the Vermont Central Railroad commenced running

its butter cars, supplied with ice, once a week during the summer months, between St. Albans and Boston, Tuesday was the day selected as the most convenient day for all concerned.

During the hot weather butter is mostly brought in early in the morning, and by noon the market is closed. St. Albans presents a lively appearance on Tuesday, during the spring, summer and fall. From early morn till near noon teams laden with butter and cheese are coming in from all directions, and as they file in down Lake street toward the depot, that street becomes packed in one dense mass of horses and wagons. Teams are hitched at every post on Main street; the hotel barns and yards are full; the hotels are full, and the farmers—I mean their pockets—are full. Butter is King.

The prominent buyers now in business are J. H. Pease of North Fairfax; H. H. Bowman, H. B. Soule and S. C. Noble & Co., of St. Albans; R. B. B. Kinnerson and F. H. Marshall, of Boston; J. E. Toof and E. L. Hibbard, of Franklin; John H. Draper of Sheldon, and some others, all of whom stand well as fair dealing and honorable men. Some of them have followed the business since the market was opened (now over twenty years). The scene, when the buyers, crowding in among the teams in the streets, are engaged in buying the butter and cheese of the farmers, is a very exciting one.

At first, for some years, most of the butter and cheese bought at this market was consigned to commission merchants in Boston. But for a few years past it had been bought at a commission by these buyers, for Boston dealers. The usual commission for buying is one cent a pound. It requires great experience and skill to be a good butter buyer, and many fail in this respect. It takes years to edu-

cate the senses of taste and smell up to the standard of a first rate judge of butter.

There is usually a friendly feeling existing, both among the buyers themselves and between them and the farmers. There has never been but one attempt to "make a corner" in butter in this market. In 1856, B. F. Rugg, who was then engaged largely in the produce trade, (and who has been the heaviest dealer in the county and State, though now retired with a handsome fortune,) undertook to carry out a plan for controlling the Boston butter market. Boston, during the hot weather, is very largely supplied with butter from the country, and to keep back a large quantity of it has the effect to advance the price. This Mr. R. well understood, and having brains and energy, with unbounded confidence in his own ability to carry out so gigantic a scheme, as well as excellent credit, he made his arrangements at the various banks in the county for an unlimited supply of means. He began buying toward the last of June when butter was low, and quietly stored it away in cellars. This he continued through July and August, sending to market only a small supply from week to week.

Before August was past, in consequence of keeping this large amount out of the market, butter began to advance in price. Mr. Rugg still continued to buy, and when he could buy no more, advised the farmers that still had butter to hold on for higher prices. This they are only too willing to do on a rising market, and their prices became so extravagant that buyers could not buy. Now he had them. Boston had to submit to St. Albans. The profits of this little speculation amounted to the snug little sum of $18,000; so says the gentleman himself, and nobody doubts it. The next year (1857,) he attempted to repeat the operation,

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but the disastrous financial crisis of that year interrupted his plans, and although he did not fail, he probably lost quite as much as he had made the previous year. The following figures show the progress of the butter business in St. Albans during the last twenty-one years:

| | Cheese, lbs. | Butter, lbs. |
|---|---|---|
| 1851 | 555,228 | 1,192,967 |
| 1852 | 601,969 | 1,149,225 |
| 1853 | 1,122,703 | 1,939,354 |
| 1854 | 1,035,376 | 1,712,404 |
| 1855 | 966,287 | 1,715,127 |
| 1856 | 1,228,128 | 2,293,568 |
| 1857 | 825,162 | 2,364,745 |
| 1858 | 1,294,393 | 2,713,309 |
| 1859 | 1,247,288 | 2,424,969 |
| 1860 | 1,984,000 | 2,566,700 |
| 1861 | 1,481,716 | 2,732,209 |
| 1862 | 1,281,602 | 2,420,370 |
| 1863 | 911,842 | 2,863,576 |
| 1864 | 923,210 | 2,472,854 |
| 1865 | 1,174,261 | 3,035,257 |
| 1866 | 882,495 | 2,617,095 |
| 1867 | 925,357 | 2,720,284 |
| 1868 | 948,276 | 2,606,880 |
| 1869 | 736,920 | 2,875,060 |
| 1870 | | 2,945,450 |
| 1871 | 435,000 | 3,270,182 |

The total quantity of butter shipped since 1851 is thus seen to amount to 50,631,595 pounds, or about one million tubs. At 30 cents a pound this would amount to $15,189,-478. The cheese shipped in the same time (estimating 1870, for which the figures are not given,) would be about

21,000,000 pounds, which at 14 cents would come to $2,-940,000; the total of butter and cheese being thus $18,129,-478. The butter in tubs set side by side would reach 230 miles, or counting 40 tubs to a load, the teams required to draw it would cover 150 miles of road.

Doctor Sherman added, in relation to the Market itself, that some organization, with a fee for membership, might be of some advantage. Still, the buyers are first class men, and each knows it is for his advantage to deal fairly, otherwise he loses the confidence of the farmers and cannot buy at all. About one tub in three is prime, one fair, and one poor. There are men who uniformly get three or four cents over the highest market price for prime butter.

After the reading of Dr. Sherman's paper a brisk discussion sprang up in reference to the high prices reported to be paid in the Boston market for what is called "gilt-edged butter."

O. S. Bliss, Secretary Vermont Dairymen's Association, stated that he had conversed with Mr. Hovey, who sells this butter in the Quincy Market, and was informed that it is Jersey butter, made from sweet cream, very slightly salted, brought in twice a week, and taken the same day by regular customers. It lacks the flavor of Vermont butter, and Mr. Sargent, the dairyman, who gets $1.10 per pound for it, uses Vermont on his own table by preference. The demand for this kind of butter is very limited. Mr. Waring, of Rhode Island, sends the same quality to the same dealer, but gets only 75 cents, because no customer has yet been found for it at Mr. Sargent's price. Mr. Hovey's customer for Mr. Sargent's butter pays $1.25 for it.

There was some discussion as to the proportion of the butter product of Franklin County to that of other counties.

Some butter from Canada is sold at St. Albans, but a part of the product of Franklin County is bought at Georgia and Swanton. The receipts at Georgia are 200 to 300 tubs weekly, a part from Lamoille County. Altogether, it is thought the sales in St. Albans represent nearly the product of the county. According to the U. S. census returns for 1870, the product of Washington County is but little less than that of Franklin.

Col. Clarke, of St. Albans, regarded Franklin's pre-eminence in butter as mainly due to the extra inducements in freight charges offered by the Railroad to shippers from that point, the terms being better than even from some points not over fifty miles from Boston. This benefits not only the farmers but the Railroad. Barre is believed to be the best farming town in Vermont, having the most good and least waste land, and Montpelier might have as good a butter market as St. Albans with the same facilities for shipping. The other markets are gaining, especially Richmond and Vergennes; and now the Rutland road is controlled by the Central, better facilities will be given along its line.

Mr. Chapman of Middlebury had had some experience in making "gilt-edged" butter in Maryland. It is marketed as soon as made, with but little salt and little worked. There are some who pay large prices for such butter, but the market is small.

Mr. Bliss spoke of the creameries in New York. They were designed as reservoirs for milk usually sent to the city markets, in order that when there was an attempt on the part of the milk-buyers to cut down prices, the supply might be turned into the creameries and so the price be kept up. It is then set in water tanks for twelve hours, the cream taken off sweet and churned, and the milk made into skim

cheese. The butter is marketed at an extra price, but will not keep. In answer to a question, Mr. B. said there were but two or three dairies in Franklin County using deep pans (milk 9 to 12 inches deep,) but the Jewett pans, setting the milk at 4 to 6 inches, are more common. There is no doubt about the advantage of deep setting as giving a better quality of butter, but there is some in regard to the yield. This question is not thoroughly settled by experiment. In regard to the average yield of butter from a certain quantity of milk, Gardner Weeks' experiments give an average result of one pound of butter to 25 lbs. of milk. The figures given at different dairies in Malone, N. Y., where the Jewett pans are used, were, respectively, one pound to 22 31-100 ; 22½ ; 21½ ; 22 55-100 ; 23⅛ ; 20 5-7 ; 25 1-10. These are the best figures yet given. Mr. Buck of Buck Hollow uses pans twelve inches wide and of the same height, surrounded with water on sides and bottom. This is more philosophical than the Jewett pan, which cools only from the bottom. Mr. B. doubted if milk much over 4 or 5 inches deep could be cooled in the Jewett pans.

Mr. Chapman stated that Mr. Douglas of Whiting has satisfied himself of the advantage of deep setting. He sets his milk in pails, placing them in a tank with ice. Mr. Douglas does not approve of using ice when cold spring water can be had in sufficient quantity.

Mr. Bliss said experienced dairymen are satisfied that ice is injurious to milk when it is allowed to touch the milk vessel. It seems to disorganize the milk. The right temperature for the milk set to raise cream is from 55° to 58°. It was thought to be the best plan by some to cool the milk to this temperature, and then withdraw the water.

# WHAT BREED OF CATTLE SHALL WE RAISE?

A PAPER READ BEFORE THE MEETING OF THE STATE BOARD OF AGRICULTURE, AT ST. ALBANS, MARCH 7, 1872,

BY ALBERT CHAPMAN, ESQ., OF MIDDLEBURY.

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The worthy Secretary of this Board has requested me to read a paper at this meeting upon the above subject. I cannot hope to present much to the dairymen of Franklin County that they do not already know much better than I do, but all have their individual experiences, and have observed facts, which, when put with those of others, together make up a mass of information of much practical value.

We are much in want of accurate, critical and impartial trial of the different breeds of all our farm stock, under the same treatment, and in the same location. This, unfortunately, we seldom have. We have many trials of the different breeds of cattle, something like the following:

Farmer A., finding that the old mongrel race his father left him, or that he has been keeping for a number of years, gives indifferent results, concludes to try some of the improved breeds, hoping thereby to realize more profit. Accordingly, following some fancy that had been planted in his mind by the specimens he has seen exhibited at some fair, he selects some specimens of the breed his fancy dictates. Having invested a goodly sum from his hard earnings, he naturally gives them much better care and attention, and

they prove more profitable than his old mongrel stock. The result is such as might be anticipated—he is fully confirmed in the opinion that his judgment was correct when his breed was selected. His neighbor B., having a similar experience with another breed, is equally sure that his judgment was better than that of his neighbor A., and that the breed he had selected was much more profitable than any other; while farmer C., with more caution than either, has, with care and thought, and unprejudiced by fictitious fitting and show animals, selected a breed that is much more profitable than either. All these are perfectly honest in their convictions when they advocate the superior claims of the breeds they have tried, and are by no means open to the charge of endeavoring to deceive others, when they recommend their favorites. The great trouble is, two of them have deceived themselves as to the comparative merits of the three breeds on trial, while they have not been deceived in regard to the superior merit of what they have tried, as compared with what they were keeping before. There is hardly a doubt but any of the improved breeds, with good care and keeping, will prove more profitable than the old mongrels, with neglect and short allowance.

There is another source of difference and speculation: that is, the results of breeding bulls of the improved breeds upon the common stock of the country, as experienced everywhere, especially as it affects the dairy qualities of the resulting progeny. For such a cross a bull may be selected from a stock of cattle of very indifferent dairy qualities in themselves, and bred to common, mixed stock, and the results will, in a large proportion of instances, prove a better average of milkers than the breed from which the bull was selected, or the stock upon which he was bred, produced. But this result would be far from proving that much better

milkers might not have been obtained by breeding from a bull selected from a stock noted for real superiority in dairy qualifications. Many may be influenced and satisfied by the success of such an experiment too much to investigate the matter and adopt a better and more profitable plan.

Another great cause of difference in opinion is, the great variation in the several animals of the same breed, and the want of knowledge of this variance. Among all our farmers how few have any accurate knowledge of the variation in their own herds, or their real comparative value. They know that "Old Spot," weighing eleven or twelve hundred pounds, gives a pailful or more of milk, but they have never tested the quality, separately, to determine whether the two thirds of a pailful they get from "Little Brindle," weighing seven or eight hundred pounds, may not make even more butter; and often, for want of the knowledge such a trial would give, the more profitable "Little Brindle" is sold at two thirds the price that could have been procured for the larger cow, and "Old Spot" is kept for a number of years at a much greater cost, and her owner deceives himself with the idea that he has retained the most profitable cow. But the farmer's good wife often detects the difference. She finds that with "Little Brindle" has departed the greater part of the golden butter. She finds that although she has nearly as much milk, she does not get her cream as quickly or in so large quantities, and that the process of churning is much more tedious, and the product of an inferior quality.

As an illustration of this want of knowledge of the difference in the value of the milk from animals of the same herds, I would mention that in a very critical trial of the milk of a herd of the Jerseys, of which I had charge a number of years, the quantity of milk that was required to make a pound of butter was found to vary with the different cows

three or four quarts, and the cow that we all thought gave the richest milk, proved hardly on a par with the average. The color of the milk was very rich, but it did not contain so large a percentage of butter as some others that had not been rated so high. We kept an account of all the income from each cow, and when the balance was struck at the end of the year, this cow was found in debt, while an actual profit of over a hundred dollars had been realized from cows that had been regarded inferior to her, and over which she had generally been awarded premiums at fairs where they had been exhibited.

As a help to determine what breed of cattle we shall raise, it would be well to look at the qualities most desirable for the cattle breeders of Vermont. Our rigorous climate, our hilly pastures, and often scanty herbage, with the sharp droughts we so often experience, and the high price of hay and grain, must be taken into consideration. The breed must be hardy; if they are not, they will surely suffer on three fourths of the farms of our State. They must be a breed that will furnish good milkers, not occasionally a good or even an extraordinary one, but uniformly good, and the more nearly we approach to surety in this quality, the more popular and profitable will they prove. We take it that no breed of cattle can long prove popular in Vermont, that depends upon the profit of beef raising, without a good show of fair milking qualities; but we should have a breed that will prove of fair average for the shambles. We also believe that so few working oxen are used in these times, that we can hardly sacrifice very much in the dairy qualities in favor of a breed that will produce the best workers. We should have a breed that will furnish not only a good quantity of milk, but that rich, in either cheese or butter; and

the breed that can furnish the maximum in the union of the two qualities combined will commend themselves highly to the dairymen of Vermont.

We are far from the opinion that it is necessary to keep a large race of cattle to make beef profitably, and therefore take but little stock in the idea that we must have large cattle because "the end of all cattle is beef." The cost of production, not the size of the animal or the number of pounds, determines the profit. There are many hilly pastures in Vermont where beef might be made with profit on Devon or Ayrshire steers, that could not make a remunerative return if fed by cattle of larger frames. In support of this position I will quote one of the greatest admirers of Shorthorns in this country, Mr. L. F. Allen, editor of the Shorthorn Herd Book, who, in the Report of the Department of Agriculture for 1866, says: "While commending the Shorthorns for our severe climate and to all localities where good pasturage abounds with sufficient winter fodder, there are places to which I would not take them; localities of wide breadth, where it is difficult for even our native stock to thrive. There are mountain ranges, which, although producing sweet and nutritious herbage, are so difficult of access by reason of their broken surfaces, that only the lightest and nimblest cattle can graze them, and they literally have to toil for a living; in such localities a lighter and nimbler breed may thrive, while the heavier and more sluggish Shorthorn would decline."

Another friend and admirer of Shorthorns will be cited as authority to prove the want of fitness of large cattle to adapt themselves to a large portion of Vermont lands: namely, Mr. Francis M. Rotch, who, in the Report of the Agricultural Department of the Patent Office for 1861, says: "Suppose we take two young Shorthorns as nearly alike as

possible. We know the characteristics of this race are size, early maturity (?), a propensity to fatten, and a quiet temper. Place one of these animals on the rich blue grass pastures of Kentucky, or the fertile bottoms of the Ohio; he will grow and spread and luxuriate in his ample feed and easily gained livelihood; he will lie down and grow fat; he will mature even earlier and reach to greater size, perhaps, than on his native Yorkshire wilds, and will prove himself the fitting type for his new home. Place the other animal upon the granite hills of New Hampshire, or the arid plains of Texas, and the result will be widely different. Want of the succulent grasses and luxuriant abundance of food he is accustomed to will affect his growth; the increased labor in collecting enough of the scanty herbage to satisfy his appetite will wear upon him; his form will alter; his capacious frame will never be filled out; he will become flat-sided, lighter carcassed, with a larger proportion of offal. His very temper will be changed; habit will induce activity and restleness, and with them he will lose much of his fattening propensity—a quiet disposition being all-important to kindly feeding. Bring these two animals together after some years, and we shall scarcely recognize them as the same race. Each has adapted itself, in a measure, to the requirements and capacity of its locality; the one has improved upon, the other degenerated from, the original race."

Many dairymen keep large cows of indifferent milking capacities, under the impression of their greater profit, as they will bring more for beef when they have passed the age of usefulness as milkers, without ever making any estimate of their greater cost of keeping, or a comparative estimate of the difference of the value of the products between an indifferent and a *good* cow. There are those who are keeping ten large cows to get the same amount of butter that is often

returned by five smaller ones, because of the greater worth of the larger cows when turned for beef. This relative ability to make beef and butter is seldom appreciated as it should be. Cows are usually kept in the dairy for about ten years. If the difference of the yield of butter is only two pounds per week, for twenty-five weeks in each year, we have the amount of five hundred pounds as the difference in the yield for ten years, enough usually to pay for all the beef both will make when fattened. The difference in the profit of the two does not consist in this alone. The cost of keeping the larger cow is more, though it is often contended that the larger milkers will consume more in proportion to their size than those giving less milk, which, if we admit to be so while giving milk, is not the case during the period of growth before coming in milk, or while dry each year, or while being fattened.

A digression will here be made to call attention to one point, calculated to affect the value of different cows, or different breeds, for the dairy. Good cows from breeds that furnish exceptional good milkers are more likely to prove defective in their milk vessels, and be troubled with garget and its kindred evils, than those from a breed that have been bred for milkers, and by a long continued development of the milk vessels have rendered them more perfect.

Large cows are not usually the best milkers, nor do they give the richest milk. Prof. Voelcker, of England, in an article on "What Constitutes Good Milk," says: "Generally speaking, small races, or small individuals of the larger races, give the richest milk from the same kind of food."

The farmers of Vermont can hardly afford to keep cattle for fancy alone, though we would not contend that any of the improved breeds might not be profitable under circumstances suited to their requirements; still our judgment

may be materially affected by a fanciful and stately appearance; but the breed that becomes most popular in Vermont must be one that pays, not only under favorable surroundings and with liberal feed, but with the ability to make profitable returns under unfavorable circumstances and sometimes scanty keep, often with neglect. A breed that will thrive and pay a profit on short commons and neglect, will pay a proportionate profit when well fed and cared for; at least the ability to pay under the poorer treatment would not disqualify them for paying under better, and while so large a proportion of the farmers of Vermont let their stock take their chances, this quality should have great weight in determining what breed we shall raise. We hardly expect any one breed will satisfy all, or prove more profitable under all circumstances, but think there is one that will give better general returns for average care and keep, and thus more likely prove satisfactory to the mass of Vermont farmers. An examination of the characteristics of some of the leading breeds may help perhaps to better determine what breed we shall raise.

### SHORTHORNS.

In this examination we will notice the Shorthorn, the most noble in appearance of all the breeds, and under favorable circumstances one of the most profitable, one of the most extensively introduced of any, and of which there are probably more good, thoroughbred herds in Vermont than any other. On the best grazing farms in our lake towns, as well as on many of the richer valley farms, the Shorthorns, in the hands of thorough, liberal farmers, are and will prove profitable. Probably no breed is as much an artificial production as this; they come to us from the most painstaking, careful and scientific breeders in England. They have been the favorites of the nobility of all of those parts of that

country richest in grazing lands, and have been in the hands of men noted for high keeping and show, without regard to cost. They have been introduced into this country by men noted for the liberal care of their stock.

A successful breeder of Shorthorns is generally a liberal, whole-souled farmer, and high in rank among nature's noblemen. The best and most successful breeders of Shorthorns in this country, as well as in England, claim for them superior excellence as producers of beef, discarding and disclaiming any idea of their being superior milkers. This is the taste as well as the rule that governs their practice as breeders. Some breeders of less note, by close breeding in some milking strain, and sacrificing some of the best points as beef cattle, have produced many excellent milkers and a few extraordinary ones, but no one has yet produced a herd that can be depended upon to furnish uniform good milkers, and the quality is generally regarded as inferior. Mr. Gold, at the dairyman's meeting at Rutland, took that position, and we again quote from Prof. Voelcker's article on "What Constitutes Good Milk." "Where good quality is the main object, Alderneys or Guernseys unquestionably are the cows that ought to be kept, for they give a richer cream than any other kind in common use in this country; but of course Alderneys are not the most profable stock for cow keepers in towns with whom the Yorkshire (essentially a Shorthorn) is the favorite breed, as it surpasses others for the quantity of milk it yields. The milk, however, compared with that of the Alderney or Ayrshire cow, is more watery and less rich in butter, and therefore not well suited for dairies in which butter and cheese are made." If I have a right understanding of the subject, the Yorkshire cow is more nearly like the old race of Shorthorns before the late improvements to make them carry the

present large amount of beef, and to prove the correctness of this idea, I will again quote from the article of Mr. Rotch. He says:

"In one respect, however, we confess the old Shorthorns completely bore away the palm from their descendants. We refer to the milking property, once the distinguishing characteristic of the race. The breeders of the present day have voluntarily sacrificed this valuable quality for the sake of acquiring an earlier maturity and a greater propensity to fatten. Beef! Beef! has been the cry from one end of the kingdom to the other, as its large population became denser and food must be found for them. Butter and cheese, and milk even, were luxuries compared with *meat*, and therefore, the production of the greatest amount of meat in the shortest possible time, and with the least consumption of food, became the Shorthorn breeder's great aim. So far have they carried this, in common, we must add, with the breeders of almost all the other improved races, that this constitutional and valuable quality of the original Shorthorn has in many cases been almost destroyed."

With good rich pasture in summer, with warm comfortable stables in winter, with constant nice care and attention, and with liberal feeding from an attentive and never grudging owner, the Shorthorns attain a noble size and appearance, and are undoubtedly profitable. Without them they are seldom useful or ornamental. Are the farmers of Vermont ready to accord all these? Are their farms all so situated that they can if they will? Are the mass of them able or willing to pay the cost?

### HEREFORDS.

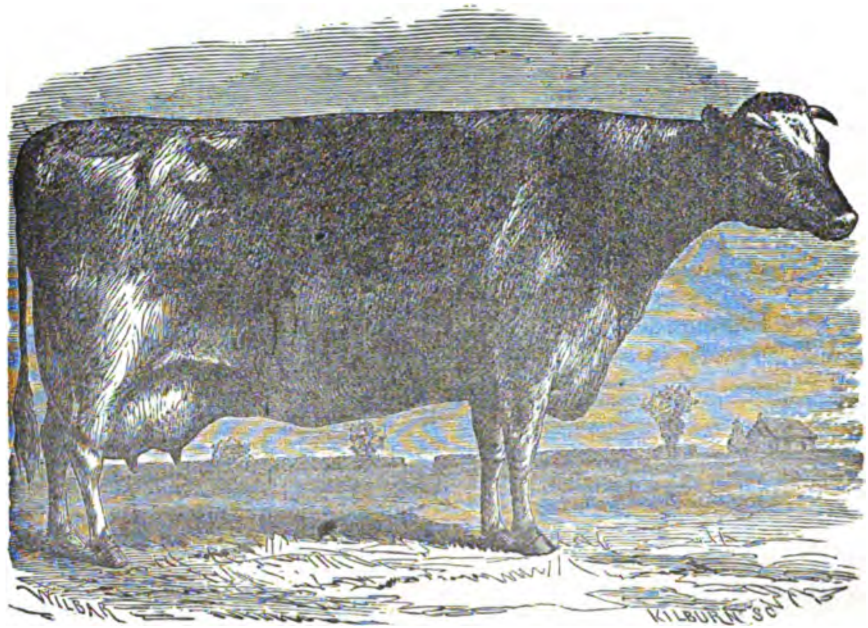
The greatest rival of the Shorthorn among the English graziers is the Hereford, one of the oldest races of that

country, whose uniformity of color, size and shape, is much closer and more fixed than the former. With nearly equal size, remarkable symmetry, thrift and early aptitude for laying on flesh quickly on the most valuable parts, he deservedly ranks high on the lists at the English markets, shows and shambles. In this country he has never attained so great popularity as in his English home. A part of this failure here is due perhaps to the injudicious claims made by the introducers* of this breed for the cows, as good for the dairy. Expectations thus raised have proved disappointments. As producers of most excellent beef they are probably more hardy, and perhaps more profitable than the Shorthorns, though it cannot be denied they have failed to make themselves as great favorites with our American breeders.

Our mixed husbandry demands at least fair milkers. While the Shorthorns answer these moderate expectations, the Herefords seldom satisfy those who expect profitable animals for the dairy.

### HOLSTEINS.

The Dutch cattle, or as I believe it is settled they are to be called, the "Holsteins," are of large size and remarkable color, clear white and black, in large belts around the body. The admirers of this breed claim for them extraordinary milking capacities, but I have not heard any claims for them on the score of quality, or capacity to make large amounts of butter, and judged by the same rules that we apply to other breeds, they evidently cannot furnish milk rich in cream, and by the same standards they would be likely to give a large flow of milk for a comparatively short time, but would not be likely to continue the same through so long a season as some other breeds. My opinion of these cattle is




DUTCH OR HOLSTEIN COW, EBONY.
*Property of Thomas Baker, Barton, Vt.*

formed from observation only, as I have never had any practical experience with them, but from experience with others we may judge somewhat of their probable fitness for Vermont, and judged by that standard, we cannot think that cattle of their size and make can prove as profitable as a finer boned, more compact, and consequently an easier kept and more hardy race.

Of all the herds of these cattle we have seen, those of Mr. Thos. Baker, of Barton, come nearest the mark of good dairy stock; and from their size, build and general qualities, better adapted to Vermont than any we have seen. Having been longer imported and kept in this climate, they are probably better fitted for it; and as all animals are inclined to yield to climatic influences and surroundings, they have no doubt become somewhat distinct, improved, and better adapted to Vermont than the later importations, without losing the purity of their blood.

DEVONS.

Among all the races of cattle, none are so beautiful as the Devons, none are more hardy, and none make as beautiful, lively working oxen, or are as tractable, taking to the yoke readily and performing their work with great alacrity. Though much less in size than the Shorthorns and Herefords, they are equally as good feeders, and for short pastures much more profitable than either. Had they proved as profitable for the dairy as they are superior in the other respects named, they would have been the most popular race of cattle for New England.

There is much variance among the breeders of Devons themselves as to their qualities for the dairy. Messrs. Turner and Quartly, in England, and Mr. Wainwright, of this country, three of the most celebrated breeders, disclaim any

superior qualifications in this respect, while Mr. Bloomfield, in England, with the late Messrs. Patterson, of Maryland, and Hurlburt of Connecticut, as well as Mr. Hyde of the same state, and others, claim them as producing milkers equal to any other breed. However firm these gentlemen may be in their belief, they have failed to inspire a like confidence in their faith among the farmers of this country, and I think it cannot be denied that the popularity of this beautiful race is manifestly on the decline. Their extreme hardiness, excellent qualities for the yoke, and the readiness with which they fatten into an excellent quality of beef at a comparative low cost, entitles them to consideration, but they cannot be ranked high for the dairy. I had charge of one of the finest herds of Devons in the United States for a number of years, on a farm where was also kept a herd of Jerseys. This herd of Devons combined some of the finest animals, direct from the herds of Quartly, Turner and Bloomfield, in England, and from those of Patterson and Wainwright in this country. Among these and their descendants, were many successful prize takers at state and national shows in this country, and some in England. Some of these from the herds of Bloomfield and Patterson were selected for their breeding and prospect for the dairy, as the most promising among this breed, but the result of a trial of them as dairy cows was unsatisfactory. Although some approached a fair average, none excelled, while a large majority were indifferent to very poor milkers.

In trials as to the richness of milk, one produced a pound of butter from 10½ quarts of milk, but she had been giving milk over eight months, and was therefore at the maximum richness, as the cow was nearly dry. In all other cases the milk was below an average as to richness, and none gave as much milk per day as some of the Jerseys. A number of

breeders in our section of the State have discarded the Devons for want of this dairy quality, and are now keeping other breeds.

### JERSEYS.

The Jerseys, or Alderneys, are justly celebrated for the extraordinary richness of their milk, and where butter alone is the object sought for, can furnish a larger per cent. of it than any other. The Jersey cow is usually a strange jumble of beautiful points and parts so joined together as to fall short of making up a perfect whole. She usually has little or at least very imperfect capacity to produce profitable beef. As a race, they want that rugged hardiness that will enable them to stand the cold climate of Vermont, or the imperfect care that most of our large dairies get, but for butter alone where good care, housing and generous keeping are accorded, these cows are very profitable. There is much variation in this breed in their profit. From a careful trial and account of expenses kept, and returns from each cow in a herd, the profit returned varied from minus to $213.50. The most beautiful in this breed is not always most profitable. The cow that received the first premium as the best Jersey at the United States show, at Cincinnati, 1860, gave a balance of only $12.93 in her favor for a year. The cow that had carried off the first prize and one second at the United States show, and first and second at a state show, (in both cases with strong competition) came out behind—did not even pay her expenses. As a rule, no breed can probably produce so much butter from a given amount of weight per cow as this, but the milk is deficient in casein, and except in butter, probably poorer than any other. This defect in the milk, with the want of hardiness, and a fair amount of beef producing capacity, will prevent this race from becoming universally adopted by Vermont farmers.

## AYRSHIRES.

Fortunately for Vermont farmers there is a breed that will fill their requirements, perhaps not to so full an extent on some single qualifications as some of the breeds named, but of fair average qualifications for all. With the hardiness of the Devon, with a good average but not large size, with the ability to make beef at least profitably on poor as well as rich lands, and well adapted for all purposes on hilly lands, and with more capacity to furnish milk rich in all the valuable constituents that sustain life, and make cheese as well as butter dairying profitable, why should not the Ayrshire be named as "the breed of cattle we should raise?" These are extraordinary claims, and he who makes them should be able to give reasons for the faith that is in him; we think they are not wanting. The first evidence offered will be their increasing popularity. Compared with the Devons, Herefords, or Shorthorns, their introduction to this country is of a very late date. The first mention I find made of them in a file of agricultural papers, is in 1831. J. P. Cushing imported in 1835. He was among the earliest. I find in searching, notices of the presence of Alderneys, Shorthorns, Devons, Herefords, and Kerry cows in this country at an early day in the present century, and of most or all of them in the last century, but can find no mention of the Ayrshires until a much later period. I have no accurate knowledge of the date of their first introduction into this country, but the most of the importations have been made since 1840, and there were certainly but few made before that time. As late as 1831, I find a writer in the *New England Farmer*, in an essay on "Breeding for a Dairy Stock," saying, "It is not too much to say from experience here and in England, that of all the varieties of cows designated by the terms Shorthorns, Longhorns, and Hornless,

or by the names more limited in their application, as Devon, Hereford, Holderness, Suffolk, Denton, Bakewell, Alderneys, &c.,—no one of them has been found to give uniformly or generally more or better milk than any other. The evidence before the public, abroad and at home, is contradictory. There have been individual instances of extraordinary milkers among all, and I may go so far as to say families of extraordinary milkers among them all. The truth really is that we have yet the work to do to establish a pure milk breed," &c., &c.

It is not supposed that the writer of the above would have omitted the Ayrshires in the enumeration of the different breeds, had they been before the public at that time, or that he would have used the language quoted had they been introduced in sufficient numbers to attract attention, and it is now claimed that the great reason of their unprecedented gain in popularity is due to their ability to supply just the want then expressed by the writer quoted, when he says in the same essay:

"The writer would ask, suppose a young farmer at the present moment is about to stock a milk farm, and is willing to pay the full value of good cows—good we mean *as breeders*—where shall he go for them in New England? Where shall he be sure to find an established milk breed that will not disappoint him? He will find *improved* breeds enough, but who will venture to insure him that the improvement will not be found to consist as often in adaptation to the shambles as to the dairy?"

So surely and universally have the Ayrshires now established this reputation that all are ready to answer that they are the breed that was then longed and looked for, but at that time must have been comparatively unknown. Their first introduction into Vermont was, I think, in 1840. (I

know that was the first year they were ever in Addison county.) They have already supplanted the Devons in most sections of the State, and there is little doubt will soon become the most numerous and best paying in all. At our fairs they are fast becoming a leading feature of the cattle department, and often exceed in numbers any other breed.

At the last show of the New York State Agricultural Society at Albany, they were more numerous by one fourth than any other breed, and outnumbered both the Devons and Shorthorns, only a few years ago the two leading breeds. In the cold climate of Canada they are fast taking precedence of the other races. They seem to have the same ability to withstand extreme heat as well as cold, and they are therefore also becoming favorites at the South. Mr. Fisher informs me that he brought the first thoroughbred Ayrshire into Franklin county less than eighteen years ago, and now there are over two thousand full bloods in the country.

Many who have tried Shorthorns, have tried and been better satisfied with Ayrshires. Dr. Geo. B. Loring and William Birnie, of Massachusetts, are both now breeding Ayrshires with satisfaction and great profit, after trying Shorthorns; and the experience of H. H. Peters, formerly of Southboro in the same State, was the same. The latter gentleman kept a milk dairy at Southboro, and becoming dissatisfied with the Shorthorns as uncertain for milkers, only one in four proving good, imported largely of Ayrshires, and found them to more than answer his expectations. Mr. P. says of his herd in 1862: "I had twenty-one Ayrshire cows and heifers, some of them with their first calves, most of them too young to have reached their maximum quantity of milk, and several calved early the previous winter, yet the average per cow was over thirty pounds per day in June

upon pasture feed only—they being driven a distance, in going and returning, of nearly three miles daily."

I have inquired at a number of cheese factories the largest amount of milk delivered per cow in one day by any one dairyman, and have never yet found as large a quantity delivered per cow by the dairy for *one* day as this average for a month of Mr. Peters's herd, and this by cows all coming in at nearly the same time, and in most instances at an age more favorable than his. One of these cows of Mr. Peters gave between forty-nine and fifty pounds per day for 114 days. This milk was not poor, as over two pounds of butter per day were made from this cow. An Ayrshire cow in New Hampshire gave 800 pounds of milk in ten days; her feed was pasture and four quarts of meal per day.

Mr. Gold, Secretary of the Connecticut State Board of Agriculture, in an essay before the Dairymen's Association at Rutland, this winter, named an Ayrshire cow that gave eighty-four pounds of milk in one day, and another that gave an average of sixty-seven pounds per day, or her own weight in milk in seventeen days. A cow belonging to Mr. Wells, of Wethersfield, Conn., gave 7,000 pounds from April 1st to September 1st; the same cow gave over 5,000 quarts of milk in one year. Mr. Gold gave the Ayrshires credit for being the greatest milkers of any breed, and very hardy.

Prof. Hyde, of Massachusetts, who followed Mr. Gold, gave the Ayrshires credit for producing milk quite as nutritious for all purposes as any breed, and above the average for producing cream, and better than any other for producing cheese. Prof. Hyde also stated that small cows gave much better milk than large ones, as a rule. In November, 1865, I selected for a gentleman of Troy, N. Y., three Ayrshire heifers and two cows, that went into his stable, where

were some of the best grade Shorthorn cows I ever saw, purchased at high prices, as having proved extraordinary milkers. The next season the two Ayrshire cows (although one was but four years old) gave at least a third more milk per day than the best of the Shorthorns, while the size of the latter exceeded that of the Ayrshires in about the same proportion, and, as it was found, cost about that much more to keep. That summer it was dry, and the Shorthorns failed in their milk two or three weeks before the Ayrshires gave any indications of feeling the effects of the drouth. As all the milk was sold, no test of its richness was made.

But these examples are enough to establish the proof of their milking qualities; they could be extended to an indefinite extent, and there is no doubt but examples could be furnished in this county, where the finest dairies are supposed to exist, to place their milking qualities above a doubt.

A few authorities will now be given to substantiate their claims to the other qualities named. The late Sanford Howard, who made several trips to Scotland, and examined very fully the comparative merits of this breed, says: "To breed and perpetuate a profitable dairy stock, regard must be had to hardiness and strength of constitution, and also to such fattening tendencies as will insure a profitable return from calves fattened for veal, from steers reared for beef, and from cows which, having served their turn in the dairy, are at last dried of their milk and prepared for the shambles. The importance of these properties is not sufficiently regarded by keepers of dairy stock in this country. Even if milk was the sole object, it would be impossible to preserve a breed possessing superior qualities in this respect, without giving attention to those points of form which denote strength of constitution. It has been well observed by Mayne, that

in breeding of dairy stock we should make choice of animals possessing the two-fold character of general vigor and activity of the mammary system. These principles have been followed to a considerable extent by the breeders of Ayrshires in Scotland. Hence they claim a high rank for the breed in reference to general usefulness.

We quote from "Aitore," a celebrated authority, who says: "The chief qualities of a dairy cow are, that she gives copious draughts of milk, that she fattens readily, and turns out well in the shambles. In all these respects combined, the Ayrshire breed excels all others in Scotland, and is probably superior to any in Britain. They certainly yield more milk than any other breed in Europe. No other breed fattens faster, and none cuts up better in the shambles, and the fat is as well mixed with the lean flesh as any other; they are very hardy and active."

Mr. Goodale, Secretary of the Maine State Board of Agriculture, says of the Ayrshires that "they give more good milk upon a given amount of food than any other breed; upon ordinary fertile pastures they yield largely, and prove very hardy and docile. The oxen too are good workers, fatten well, and yield juicy, fine flavored meat."

Youatt says, "the Ayrshires unite, perhaps, to a greater degree than any other breed, the supposed incompatible qualities of yielding a great deal of milk and beef."

Comparatively few of the farmers of Vermont will be willing or are able to incur the expense of purchasing an entire herd of cattle of any breed, hence if they would improve those they have, or indeed keep them from deteriorating, they must have recourse to crossing, and it would be well to consider this part of the subject.

It is now generally conceded that it is poor economy to

use a grade bull of any kind. If a bull of the improved breeds is to be used, which one will be most likely to furnish one that will give the greatest improvements in the qualities desired? In 1840 an Ayrshire bull was introduced into Addison county and kept for ten years near Middlebury, when he was removed and kept a few years in Ferrisburgh. There was much choice stock of Devon and Shorthorn blood in both these localities, but this bull made very marked improvements in the qualities of hardiness and aptitude of fattening, as well, also, as in the dairy qualities of his stock. In a trial of three young cows sired by him, with the addition of another for two weeks in June, 80¾ pounds of butter was made, beside supplying a family of nineteen with milk and cream during the time. During the last week in September following, and after they had been in milk about six months, the three without the addition of the fourth, (whose milk was kept separate for use in the family,) yielded a fraction over 30 pounds. The butter in both cases was of superior quality. One of these was a heifer only three years old, and this her first season in milk.

To this day some of the best dairy cows in the localities named trace their pedigree to this bull, and so well does his stock stand, that a possession of one-fourth or even an eighth of this blood will at this time materially enhance the price of dairy cows among those acquainted with the good qualities of his stock. A cow sired by him was kept until twenty years old at Middlebury, maintaining her profitable usefulness until that time, when she was fattened with profit. His stock was always noted for hardiness and longevity. Other such instances could no doubt be cited in other parts of the State.

Upon this question of the value of the different breeds for crossing, the authority of Mr. Flint in his work on Dairy

Farming will be cited. Of the Ayrshires Mr. Flint says, "they are admirably adapted, in my opinion, to raise the character of our stock to a higher standard of excellence. They have been bred with reference both to quantity and quality of milk, and the grades are usually of a very high order. The best milkers I have ever known, in proportion to their age and food, have been grade Ayrshires; and this is also the experience of many who keep dairies for the manufacture of butter and cheese, as well as for the sale of milk. I have taken great pains to inquire of dairymen as to the breed or grade of their best cows, and what they consider the best cows for milk purposes, and the answer has almost invariably been the Ayrshire and native. If any improvement has been made in our dairy stock, apart from that effected by a higher and more liberal course of feeding, it has come from the Ayrshire."

Mr. Flint's opinion of the value of the Shorthorns and the Devons for improving our dairy stock may be referred to here, his objection to using them being based on their having been bred mainly for beef, and therefore not to be depended upon to improve the dairy quality of our common stock. His objection to the Jersey for the same purpose is their lack of yielding milk in large quantities, which in dairies selling milk or making cheese would be fatal to them, while their forms and proportions are not beautiful or symmetrical.

Z. E. Jameson, Esq., of Irasburgh, endorsed Mr. Chapman's paper, but spoke favorably of the Dutch stock for the dairy.

Mr. Chapman said he preferred the Dutch stock of the Jarvis importation, as seen in the herds of Mr. Baker of Barton, and others, to any breed except the Ayrshires. But

he was by no means as well pleased with the Chenery herd of Dutch or "Holstein" cattle. Thought them too large, and inferior as milkers.

A. Fisher, Esq., of St. Albans, said that he began with Ayrshires in 1854. At that time the judges at the fairs would not look at them. But he thought then that they would, in time, and they have. He endorsed Mr. Chapman's opinions, but preferred half blood grades to full bloods for the dairy. Don't use grade bulls, though; that is preposterous, and you can never tell what you will get from them. The half bloods of his herd average thirty-seven pounds of milk a day, yielding 10½ pounds of butter a week. Heifers give one pound of butter a day, old cows 1¼ to 2¼ pounds. He was sure that the extra value of half blood heifers more than paid for extra cost of bull. Ayrshires fat well; prefers cows that dress less than 600 lbs. rather than over. Never has had garget with his Ayrshires, either full or half blood. They are good grazers and feeders. Had tried Shorthorns, but preferred Ayrshires.

O. S. Bliss was sorry there were no Shorthorn men there to speak of their merits. He went for Shorthorns for the better lands of the State. In regard to the Dutch cows, which Mr. Chapman thought did not hold out well in their milk, Mr. B. said that Mr. Chenery, and Mr. Houghton of Putney, both think they hold out remarkably. They are, however, rather cheese than butter cows. It is Gov. Hyde's (of Conn.) conviction that the Devon is the best butter cow, and the experieuce at the Massachusetts Agricultural College is the same. Thought the Peters herd of Ayrshires now superseded by better importations.

Mr. Fisher expressed it as the result of his own observations that the recent importations of Ayrshires were not the

best. There are better Ayrshires now in this country than can be found in Scotland. Thought Mr. Peters' herd was a good one, but Campbell (of New York Mills, N. Y.,) has large capital and gives extra care. Mr. Fisher spoke of the cost and value of butter, and thought it could not now be made at a profit under forty cents a pound.

Mr. Chapman said he was well acquainted with Gov. Hyde's Devons. They are not equal to Ayrshires for milk. He also spoke in praise of Mr. Peters' herd.

Mr. Seymour, of St. Albans, went into the history of Mr. Peters' herd. Mr. Howard, one of the best judges in this country, had *carte blanche* to buy the best in Scotland at any price for Mr. Peters, and selected three bulls and twenty-seven cows at a cost, on arrival in America, of about $1000 each. Mr. S. thought Shorthorns and Ayrshires a good cross for the dairy.

# HISTORICAL SKETCH OF THE DUTCH OR HOLSTEIN CATTLE NOW IN THE UNITED STATES.

BY Z. E. JAMESON, SECRETARY OF THE ORLEANS COUNTY AGRICULTURAL SOCIETY, AND A MEMBER OF THE VERMONT STATE BOARD OF AGRICULTURE.

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When we consider the history of this country it does not seem strange that we should be more familiar with English manners, customs, manufactures and products than those of other countries. The constant commercial intercourse with England has afforded ready means for the importation of stock of all kinds. The similarity of language has rendered transactions easy that would be difficult with a nation of another tongue, and with whom there was much less intercourse. Many importations of cattle have been made from the British Islands to Canada and the States, and by herd books breeders can know who owns animals related to their own, in whichever of these countries they may be found.

It is known that the rich and fertile lowlands of Holland have long been occupied by an industrious people who have made dairying a specialty, and have developed a remarkable breed of cattle, of which only a few specimens have been imported to this country. The excellencies of these are so remarkable that it is desired by the breeders, and would be beneficial to our country, to have their history and merits

more fully made known. Therefore, the following results of observation, correspondence and compilation are put before the public with a desire to benefit it. The prosperity of a large eastern section of our farming country depends almost wholly upon dairying, and this is becoming a more prominent and important industry each year. If a change of stock, or the incorporation of the qualities of a superior breed by a cross, can double or greatly increase the farmer's income, the subject is well worthy his careful consideration, and therefore no apology is necessary in presenting the proof of the truth that the income can be thus increased in dairy products, and that we also have a more desirable class of animals for every other purpose than those usually kept.

Motley, in his "History of the United Netherlands," describing Holland in the seventeenth century, says: "On that scrap of solid ground rescued by human energy from the ocean were the most fertile pastures in the world. On these pastures grazed the most famous cattle in the world. An ox often weighed more than two thousand pounds. In a single village four thousand kine were counted. Butter and cheese were exported to the annual value of a million, salted provisions to an incredible extent. The farmers were industrious, thriving and independent."

Another writer quotes from Prof. Silliman, who, in his "Journal of Travels in Holland," published in 1812, says: "Innumerable multitudes of very fine cattle were grazing upon the meadows, many of them of a pure white color, others nearly or quite black, but by far the greater number were marked by both these colors intermixed in a very beautiful manner, and we found this fact to be general, for wherever we went in Holland the cattle were black, or white, or striped and spotted with these colors. * * *. We

observe the cows in meadows covered with blankets to protect them from the dews."

Another writer in 1848, says: "The Dutch cows have been a long time celebrated for their abundance of milk. * * * They are generally of a black and white color, and in some cases are milked three times a day."

Charles L. Flint, Secretary of the Massachusetts Board of Agriculture, published a work on "Milch Cows and Dairy Farming," in 1858, and says: "The Dutch cattle are in general renowned for their dairy qualities; especially so are the cows of North Holland, which not only give a large quantity of milk, but also a very good quality." The same writer in 1863, referring to an international exhibition at Hamburg, speaks of the "long and beautiful rows of black and white cattle." The Dutch stock formed a prominent and marked feature in the show; the number of the animals was about a hundred and thirty, many of them from the finest herds in Holland.

In 1869, a writer in the *Country Gentleman* said: "During the years 1850, '51, and up to 1855, I often went to the cattle market in London, the first part of the time in Smithfield, and there were many cattle brought alive from the continent, chiefly from Holland. These were all marked in the peculiar way of Dutch cows — black, and a sheet of white across the middle. * * * The finest herd of milch cows I ever saw, so far as uniformity and large udders go, was in Hertfordshire, England, and they were bred from imported cows. Though they numbered upwards of thirty, the man who looked after them told me there was not a bad milker among them. * * * Dutch cheese and Dutch butter command a much higher price than any other articles of the kind imported into England, and though good man-

agement in Holland has most to do with this, doubtless the cattle are excellent for dairy purposes."

In 1868, L. F. Allen, late President of the New York State Agricultural Society, and editor of the Shorthorn Herd Book, published a volume on American cattle containing this in regard to the Holstein or Dutch breed. "Their surpassing excellence appears to be in their milking qualities, coupled with large size, and a compact massive frame, capable of making good beef, and the oxen are strong, laboring animals. They are almost invariably black and white in color, spotted, pied, or mottled in picturesque inequalities of proportion over the body. The horn is short, and the hair is short, fine and silky. The lacteal formations in the cows are wonderful, thus giving them their pre-eminence for the dairy."

In 1871, Prof. George H. Cook of the New Jersey Agricultural College, writing of his recent travels in Holland, says: "One of the first things that attract the attention of the traveler in Holland, is the great number of cattle. They are to be seen everywhere at pasture, and their decided colors of black and white in large spots, and not rarely black with the broad belt of white, make them conspicuous. The fame of the Dutch cows for dairy purposes made me interested to inquire into their peculiar excellences. I visited only two or three dairies and got the most definite information at one in Beemster, some fifteen or twenty miles north of Amsterdam. * * * The yearly average for twenty-six cows was 4884 quarts for each cow, a monthly average of 408 quarts, a daily average of 13.6 quarts. The cows have been selected with great care. No pedigree is kept in Holland, but Mr. Sluis judged of the quality of his cows by the size of the milk mirror, by yellowness of the

skin, the abundance of scurf on it, and the clear definition of the black and white colors. They were all carefully blanketed when I was there and were constantly in the pasture. * * * He said that it took twenty-four quarts of milk to make four pounds of cheese in winter, while twenty-one quarts in summer would yield four pounds of cheese." [Calling it six quarts of milk for a pound of cheese, these twenty-six cows would each average 815$\frac{2}{3}$ pounds of cheese in a year. Z. E. J.] "There were in Holland, in 1864, 1,233,887 cattle of which 943,214 were cows. 32,000,000 pounds of butter, and 61,000,000 cheese were exported from the country in 1864. The population of New York is about the same as that of Holland. The whole number of cattle of all sorts in that State, in 1870, was estimated at 702,000. The whole amount of butter exported from the United States from June 1869, to June 1870, was 2,039,488 pounds, and of cheese 47,296,323 pounds. There have been some full blooded Dutch cows and many grade cows of this breed in the vicinity of New Brunswick, New Jersey, and they are uniformly good milkers."

In another article Prof. Cook writes of the cows at the Agricultural College of Bonn, that nearly all the cows are Dutch, they having tried the Shorthorns and could not make a living by them.

The foregoing extracts plainly show that the few Dutch cattle in this country are representatives of an old, well established and very desirable breed, highly esteemed for their excellent dairy qualities, that cannot probably be surpassed by any cattle in the world, and that the color has been black and white as far back as any trace of their history can be found.

The Dutch cattle were first introduced into this country by the West India Company, about the year 1626, and sub-

sequently other importations were made by early Dutch settlers in the state of New York, and cattle of these colors are occasionally seen in Connecticut and Rhode Island, and old men speak of Dutch cows (probably grades) that were famous milkers in their youthful days.

Early in the present century, Hon. Wm. Jarvis of Weathersfield, Vt., imported a bull and five cows. They were bred on his farm, pure from mixture with other stock, and remain so to the present day.

In 1864, W. W. Chenery, Esq., writes of this importation:—"These cattle soon acquired an enviable reputation which has been maintained down to the present time. A few full-bloods and some crosses are still remaining on the Jarvis farm, and although they do not compare favorably with the latest importations of Dutch cattle, they are regarded in that part of the country as a very superior kind of Shorthorn cattle, remarkably good for milk, both in quantity and in quality. As working oxen they have there a very high reputation, being large, strong, well made, quick and high spirited, and have great endurance of heat. They are very muscular, and having great aptitude to fatten, the drovers and butchers have always esteemed them very highly. They are also considered, there, extremely valuable to cross with other breeds."

The following extract from a letter dated June 22, 1871, written by Russell Jarvis, Esq., of Claremont, sheds some light upon this stock. "Consul Jarvis did not breed from crosses of importations of other Dutch cattle, but bred exclusively from his own importation, and, as it is termed, bred in and in. The only Dutch cattle that I know of now, in this vicinity, are those belonging to myself, with the exception of one cow owned by his son-in-law, Leavitt Hunt, at Weathersfield."

One of the purchasers of this stock was C. W. Bellows, of Pepperell, Mass., who writes Sept. 19, 1870:—"Mr. Jones, of Amherst, N. H., and I bought all of Jarvis's full-bloods the year he died, [this would not, of course, include what might have been owned by Russell Jarvis, in Claremont. Z. E. J.] and then got some seven head of the Orange County Milk Association importation, and have bred them carefully together, and have really the best dairy stock I know of. They are not so large as the Chenery stock, but can beat them every time for dairy use. At the Manchester fair, with three head, I took two first premiums against sixty head of his and the stock from Putney. * * * I sold Mr. Carlos Pierce all the Dutch cattle he had to start with excepting one. * * * You can depend upon their milking and butter qualities."

In 1869, an article appeared in the *Country Gentleman* from Mr. Bellows. He says: "They are large enough for all practical purposes, and produce more milk and of better quality for butter than any other breed I have kept. The cows weigh from 1,000 to 1,250 pounds live weight; are very quiet and gentle; hold out through the season, giving a good flow of milk ten or eleven months, with proper food. Their butter is colored as highly as that produced by the Jerseys, and I think is finer flavored. The bulls are also quiet and gentle, so much so that I never had to put a ring in the nose to handle them at any age. They are fast walkers and the grades make the finest working oxen I have ever seen, being generally black and white, and often have black ends with white belt around the body. * * * I have one cow, that has a calf twelve days old, that has given for the past week an average of 49 pounds of milk a day, and one with a calf fifteen days old that has averaged 53½ lbs. a day, and they travel half a mile to pasture and have no

feed but what they get there." In a letter to me dated July 1, 1871, he says of these cows: "I tested the milk one week and the result was 34¾ pounds of as good yellow butter as ever was seen. Last season I had a two-year-old heifer from each of those cows come to milk, and one of them was at Manchester, and took diploma and first premium. To show how true they breed, I tested their milk by weighing every mess for a month, and they each gave an average of 35 pounds a day, and they held out until they calved in spring."

Mr. Thomas Baker, of Barton, Vt., bought several full blooded animals of the late Carlos Pierce, of Stanstead, P. Q., and, with those he has bred, has about 25 head. I have often seen them in his stables and made inquiries in regard to their merits and find it a repetition of the high praise this breed invariably receives.

Lady Bellows 2d was giving, the second week in July, the present year, 50 6-7 pounds of milk per day, and was milked twice a day. She was kept with thirty head of other cows, and had no extra chance, and the season had been a remarkably dry one. Lady Bellows had been milked thirteen months, and went dry only two weeks before calving.

His full bloods and grades, as calves, yearling and two-year olds, make very rapid growth, and grade heifers that have come to milk are uniformly good.

So from the Jarvis stock there is one herd at the present time that is pure, and the two herds of Mr. Bellows and Mr. Baker, probably numbering 40 head, that are pure Dutch. A. P. Ball, Esq., and perhaps others near Derby Line, have a few head.

As has been shown, no pedigree is kept in Holland, but the animals are selected for their good qualities. The ani-

mals from the Orange County Milk Association were not a cross, but the same blood not closely related. In regard to those cattle I have a letter from the Secretary of the Orange County Agricultural Society, D. A. Morrison, dated July 22, 1871. He says: "Several years ago, Mr. D. H. Haight, of Goshen, N. Y., imported the Dutch or belted cattle into this country from Holland. These cattle are quite numerous in the vicinity of Goshen, and they are to be found in other sections of the country. They are much prized for their superior milking qualities. Mr. Haight made several importations." No correct estimate can be made at this time of the number of full bloods in that section.

It is considered desirable by all breeders to have animals from different families in commencing a herd upon any farm, and this will further appear as we speak of other importations. It is probable that the principal herd in Vermont for many years will be that of Mr. Baker, as his large farm will enable him to increase his herd to one or two hundred head without inconvenience. He now has about 75 head of cattle and a large flock of sheep. In regard to developing this remarkable breed no one could do it more judiciously, as he is a first class dairyman, a careful and liberal feeder, and an observing herdsman, giving his personal supervision to the care of his stock. Mr. A. M. Ripley of Coventry, Vt., has a few grades that give good satisfaction in their thrifty growth, and the excellence of the few heifers that have come to milk. Mr. Selon Jackson, of North Derby, has a pair of full bloods and some grades. Although his cows are of only moderate size, the calves are large and thrifty.

Another importation still later than those mentioned was made in the autumn of 1861, by W. W. Chenery, Esq., of Belmont, Mass., a gentleman whose business connection caused him to deal somewhat in Holland and Germany.

This importation consisted of a bull and four cows, which, with one bull from a previous importation, constituted the foundation of the present celebrated herd at the Highland Stock Farm, numbering probably 75 head.

I visited this stock in February, 1869, in company with the owner. I was told that the directions to his agent at Schiedam were very explicit that the very best animals be obtained; heifers not related to each other served by different bulls, and a bull not related to the heifers; and that these directions were followed is proved by certificates of the local authorities in that part of Holland, in regard to the high reputation of the herds selected from, and is further proved by the remarkable excellence of the stock since their importation. That animals were selected from different herds is rather to their advantage in breeding.

I saw the four imported cows. They have now attained the weight of about 1600 pounds each. The milk of Texelaar had been tested very carefully. Her largest yield in one day was 76 lbs. 5 oz. In ten days she gave 744 lbs. 12 oz. In nine weeks she gave 4,018 lbs. 14 oz., equal to more than two and one-half times her live weight. Her milk yielded nearly three pounds of butter a day. It is believed the milk is especially valuable for cheese, and at the rate milk usually yields at factories the result would have been in the case cited over 400 lbs. of cheese in nine weeks. Some of the cows as I saw them were only in moderate condition. I was assured that if allowed to go dry a short time before calving they speedily regain their symmetrical proportions. The heifers and bulls were looking splendidly. They had the plump, muscular development that would do credit to a well bred Shorthorn. As we stood behind the six-year-old bull, Van Tromp, that weighed nearly 2800 lbs., Mr. Chenery observed that he was "the best bull

in America." Wherever bulls from this herd have been used with the common stock of the country, the grades have partaken very strongly of the characteristics of the Dutch stock in color, size, quiet disposition and surpassing excellence for milk. There have been but few herds of full bloods started from this importation. Chas. Houghton, of Putney, Vt., has a herd. A few animals have been sent to different parts of Massachusetts, to Maine and other states, and if my memory is correct, to California. Opperdoes 6th, is at the Togus Military Asylum, near Augusta, Me. The superintendent is "soon to import direct from Holland, through the American Consul at Hamburg, one bull, one cow and one heifer, all of different strains of blood; the order being to obtain the best animals to be found in the country."

Another importation was made, as the following letter from Gerrit S. Miller, Peterboro, Madison County, N. Y., will show. He says: "My cattle were imported by my father, in October, 1869, and have been in my possession since that time. I suppose they are not intimately related to any herd in this country. * * * I hope to have calves for sale next year. My two younger cows have heifer calves; the oldest cow has not calved yet. The two younger ones are giving daily sixty-eight to seventy pounds of milk. One six year old has given the past week over seventy pounds per day. Her greatest yield in one day was 74½ lbs. I feed four quarts of grain with a poor pasture. I milk them three times each day. I think they are the stock for our dairy districts."

I have within two years read of another importation, owned in Rhode Island — a few animals, — but I have not the particulars at hand.

In view of these facts our conclusions are, that all these

importations were made with good judgment, and with special reference to obtaining superior milking stock.

Consul William Jarvis was a man of much experience in importing. He purchased and forwarded thousands of sheep from Spain, some swine and these cattle from Holland. That a consul is a proper person through whom to obtain the best, is seen in the fact that at the present day, when commercial intercourse is comparatively free from embarrassments, Gen. Tilton, of Maine, chooses a consul as an agent to obtain Dutch cattle. In his official capacity he comes in contact with wealthy and distinguished individuals, who are often eminent agriculturists, and capable of giving aid in selecting those choice specimens of stock that shall be sent to a foreign country. Then, again, I have it from a gentleman acquainted with the Jarvis farm and stock from 1820 to 1830 and thereafter, that Mr. Jarvis was very particular in breeding his stock, and was not indifferent to its excellences and purity.

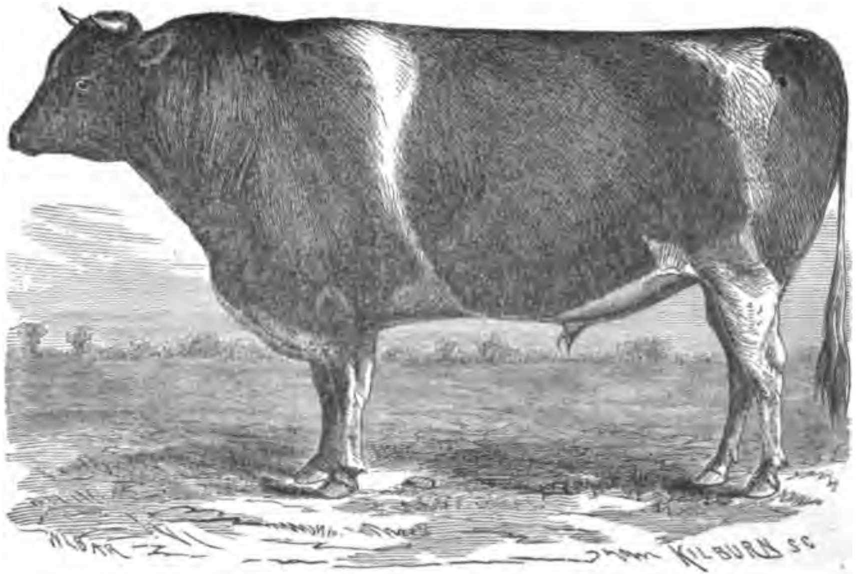
The Orange County Milk Association was organized in a county that has a national reputation for the excellence of its dairy products, and with a view of improving their already good stock, they import animals again and again from Holland, and find this Dutch stock very superior milkers. There is reason to believe they bought the very best that could be obtained.

The Chenery importation was selected from the best herds without regard to expense, and the same is doubtless true of all the others, and no sane man would select an ordinary cow for the risk and expense attending a long journey, with the idea of founding a herd of superior stock. Those ordinary animals will come when there is such a speculation in Dutch stock that any black and white nub-horned cow will

sell at a high price on account of her being Dutch and not because of any individual excellence.

Such being the case, an individual starting a herd would act as wisely to select from different herds here as others have in Holland, and the progeny would as truly be thoroughbred as the descendants of the original importations. And doubtless the gentlemen before mentioned will in time purchase animals of each other without detriment to their several herds, but rather to their advantage.

In regard to the term *Holstein*, now often applied to this stock, it is believed to be of somewhat recent application, and in no way a better term than *Dutch*. It was not used in reference to Mr. Chenery's cattle by Mr. Dadd, in 1858, and only occasionally by Mr. Flint still later, or by Mr. Chenery in 1864. It does not indicate a different breed from other importations called Dutch, or the great mass of cattle seen in various parts of Holland, and called invariably Dutch cattle. A breed of cattle so numerous as Prof. Cook found them in 1870 — indeed the favorite cattle at the Agricultural College, and among all the best dairymen in Holland — are more deserving of the national name, *Dutch cattle*, than of the name of a small district or section. When a name has become accepted, no change should be adopted without good cause. The effort to change the title of the Spanish Merino to American Merino results in more confusion of terms than existed before. It is evident that if Holstein is considered a fashionable name, Dutch cattle in Holland and across the ocean will become thoroughbred Holsteins when they are landed in America. Under whatever term they may be known, their superior qualities remain the same.




**DUTCH OR HOLSTEIN BULL, HOLLANDER.**

*Property of Thomas Baker, Barton, Vt.*

# WHAT BREED OF HORSES SHALL WE RAISE ?

A PAPER READ BEFORE THE STATE BOARD OF AGRICULTURE, AT BRANDON, JUNE 8, 1871.

BY COL. E. S. STOWELL, OF CORNWALL.

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When I received the invitation of your Secretary to prepare a paper to be read at this meeting, I thought for several seemingly valid reasons that I could not accept it; that it was out of my line to even attempt written essays, and, with the hurry of the season upon me, was not to be thought of.

But I did think of it, and with second thoughts came the conviction that it would be ungenerous shrinking from known and presented duty to refuse my mite, though small, towards the advancement of practical agriculture and stock breeding in Vermont; the more, when gentlemen whose interests did not seem to ally them so intimately to the business as did mine, were willing to devote their time and thoughts to its proper advancement and support. I consented, therefore, to write, but what should by my subject?

I presume that the Committee of Arrangements have given invitations to men in different branches of agriculture, stock raising, &c., with a view to getting a variety, and that probably one of my two specialties would be acceptable from me. But which? Would it be that the poor despised slaughtered Merino sheep, that so many thousands have hated bad enough

to kick, and would even go out of their way to do it, (I don't know why, unless the sheep bit them,) had, suddenly, under an awakening sense that just one sheep too much had been killed, that just one wool skin too many (with its three year's growth of wool) had been imported, (fleeces taken in that way cannot be duplicated,) and that there was a probable lack of raw material for textile fabrics in America, not alone, but in South America, in Australia, and in Continental Europe beside;— could it be, I say, that under these influences the Merino sheep had arisen in the scale of valuations until the people again wanted to hear what their special lovers and breeders, and may I not say without egotism, improvers, thought of their prospects? Nay, not yet. Large bodies move slowly, and the old smarts are not yet healed; only a few discern the light in the east, the sure forerunner of the day, and the people are not quite ready to hear sheep presented again.

Ah well: then it must be somebody has told somebody else that I love horses. I do, Mr. President. I do, my friends. The noblest animals of God's creation! His second best gift to man! And I always have, (I pity the man who don't,) and I have always made them, their history and their breeding, a special study, and I propose to give you in this paper my views of what kind of horses our farmers of Vermont should breed for most and surest profit, and how under existing circumstances to secure them. Perhaps I can make myself best understood by first using the negative, and stating what we ought not, because we can't afford to breed.

1. We can't afford to breed the class of horses we have been breeding — Morgans, Black Hawks, French or whatever blood they may be, of from fourteen to fifteen hands in height, and weighing from 800 to 900 pounds, for the

reason that they will cost the grower at four or five years of age more than they will bring in any market available to us. I estimate it will cost $50 per year to grow colts as they should be grown, at the least, and we all know that from $150 to $200 is a good average price for this class, and they are but little sought for at that. Horse buyers in Vermont are, and have been for several years, like angel visits, few and far between, not because of lack of buyers, but because we have not the class of horses that the market demands. Our horses are too small and too light boned, and too much pinched up.

2. We can't afford to raise the heavy draft horse, or the Suffolk Punch, Percheron, Norman, &c., for the reason that the richer fields of the west can grow them so much faster and cheaper than ours, that we shall find ourselves perpetually behind and undersold. They require rich feed and in unlimited quantities — whereas our Vermont fields are sometimes limited in their supply. However, the demand for such horses is good, and prices fair, and to western growers undoubtedly of slow and sure profit.

3. We can't, as farmers, afford to breed the *small trotting horse.* This statement, I am aware, will meet with some questionings, but I speak advisedly, and believe the experience of many thousands of horse breeders, reluctant as they may be to admit it, is proof. The Rev. Mr. Gurney, of Maine, says that although it is claimed that the breeding of trotting horses distinctively as a source of profit in Maine is a failure, yet when speed is connected with other qualities for general use and taste, such as size, color, style, &c., there is no doubt about its value and the profitableness of the business of breeding horses. (This is not strictly a literal quotation, perhaps near enough to get the idea.) The per centage of trotters is exceedingly small, even in the best

of families, although it is evidently increasing. Some writers say five per cent , others less, make trotters of special value ; at the best five trotters, ninety-five not trotters, in the hundred. The breeding of the five is remunerative to the breeder, if he is at the same time horseman enough to develop his colts and show them to advantage ; otherwise some lucky dealer gets the profit of the breeding in the fast colts, for, as it has been previously shown, small horses without speed cannot be bred with profit, and he that bears the labor and expense with the hope of gain, finds, in the end, nothing but loss, except the consolation that he has raised a good horse and a trotter.

These are some of the negatives, perhaps sufficient for the occasion—the darker shades of the picture. Are there no light ones ? I believe there are, gentlemen. A good sized, rangy, stylish, open-gaited and enduring horse of a good color, bay for instance, from 15½ to 16 hands high, weighing 1000 to 1150 pounds, will always bring a good price, and can just as well be bred, and bred fast, as smaller sizes and indifferent colors.

I was taught in my early days that the true theory of breeding was to cross a large, roomy, strong-boned, coarse mare with a smooth, stylish, trappy little horse. Mr. Bonner's mare Peerless, by American Star, from a Messenger mare, Mr. Smith's mare Nonesuch, by Lambert from Mr. Baldwin's Black Hawk and Henry mare, are examples, and in the days of Black Hawk that system gave very satisfactory results, and I have no doubt a more uniform class of horses than if bred the other way. We recall some few thus bred of excellent stamina and generous proportions, as Plato, Addison, Pathfinder, Rockwood horse, and his renowned son Gen. Knox, among stallions; Belle of Saratoga, Lady Sherman, Lady Litchfield, and Boston Queen, among

mares. Black Hawk found many good mares in Vermont, descendants of Hambletonian, Aurelius, Henry, St. Charles, Liberty, &c., and these were their produce, and the product set all the world agog; for the beauty, symmetry and general usefulness of Black Hawks bred from such mares was a wonder to all; but as those old mares have passed away, and the stock of Black Hawk interbred or bred to smaller Morgans or French, results have been to decrease size and bone, and spoil the business and our reputation, fastening upon us a small sized, chubby, rugged little horse to be sure, but degenerated in size, and without the power of recuperation, unless by slow and tedious process, of careful and discriminating selections of proper animals of the species for long series of years, too long, I think, for Yankee patience to endure. With sheep, in flocks of hundreds, ten years experience is more than a lifetime with the number of mares that we individually are able to keep. My experience in sheep has taught me that *likes don't produce likes exactly*, but intensify characteristics and especially peculiarities. Now, then, if we breed small horses the product is smaller. The Mexican mustang and the Indian pony are examples of continued degeneration in size. These small, hardy little fellows are descended, no doubt, from those horses of Cortez, considered by the Aztecs half man, and real Centaurs, and there is no reason to believe but they were of full proportion when imported, for how else could they have carried the mailed warrior, and in addition their own stout covering?

If breeders would provide themselves with such mares as were in the days of Black Hawk, small, fast stallions would produce equally good and better stock than was produced then. But will they? Is it not the tendency of nearly all to breed from what they have, especially if rendered unserviceable by hard work or strains, even if small? I think

it is, and you no doubt agree with me, and it is not so very destructive after all as we have sometimes thought, if care is used not to breed from horses having hereditary ailments, provided a judicious choice of stallion is made, for it is no doubt true the close built, sound, swelled muscled little Black Hawk or Morgan horses have as much true stamina as any in the world. I remember the remark of a gentleman, last summer, one evidently traveled aud observant, and withal a true lover of the horse. Sitting upon the Addison House steps, in Middlebury, on a public occasion, he watched the teams come in from the country. Looking up, he says: "Nowhere have I ever seen horses come into town hitched to heavy buggies, with two, three and even four loaded in, that would take their loads up such a hill as that, at such a rate of speed, without hitching, bobbing or jumping; and those sturdy little fellows don't seem to know that they have any load behind them at all." These are qualities, gentlemen, that we cannot afford to lose, and it is not necessary we should. In the last few years there has been a growing opinion in the minds of the most intelligent horse breeders of our land, that the old theory of large female, small male, though good in practice, must give place, in a measure, to the absolute facts as they are developed from day to day and year to year; that the fastest and best horses, those showing the best staying and enduring qualities, are being produced by breeding the small, fine boned, enduring, cheerful, courageous female to the coarse boned, larger sized, heavy trotting horse; the produce taking their bottom, their nerve, and their indomitable courage from the dam, and their square trotting, long, low, sweeping stride from the sire.

Such has been the result in Kentucky from crossing that coarse old horse, Mambrino Chief, with their fine-boned

thoroughbreds, and Lady Thorn, Mambrino Pilot, Bay Chief, Bold Chief, Ericson, Woodburn Pilot, Claybrino (two of our Stock Farm horses,) and many others well known to horsemen are the products. Mambrino Bertie, just purchased by Mr. Bonner, that prince of horse buyers, trotted last year, a two-year-old, in 2:40½. Such has often been the result, in Orange County, N. Y., only more so, crossing Rysdyk's Hambletonian, that double son of old Messenger, and who doubts but he is a coarse horse, if any, let them look at this his faithful likeness, [showing print], and note his big head, long ears, high hip and tail, and heavy boned, crooked and almost curby jointed leg, and be convinced.

This horse, crossed with American Star mares, that fine old descendant of the four miler Henry, has produced as many, perhaps more exceedingly fast staying horses than any other. Hiram Woodruff says: "The Messenger cross gives the Stars size, strength, and bone, and counteracts their hereditary tendency to contraction of the feet. We may say that any cross that would produce a Dexter, George Wilkes, Major Winfield, Aberdeen, Startle, Socrates, and so on to almost unlimited numbers, was a good one; but when we consider that these crosses not only give as large a per cent. of fast trotters as any other, but also to the every-day breeder a sure thing in size, style and good, slashing open gait, so that led out at four years old to the halter by any farmer's lad that could run fast enough, they would easily bring highly remunerative prices to the breeder, not only for the five in a hundred, but for the 95 withal. We have reached the point long aimed at, a class of horses in which each and every one will be worth all he costs — a class of fast horses suitable for the road in light or heavy hitch, for the wagon or the plow. Who does not know that

for every sixteen hand bay colt, of good form and gait at four or five years of age, there will be plenty of purchasers at from $300 to $500 each? And has not the experience of gentlemen that have bred thoroughbreds to Abdallah and Mambrino Chief in Kentucky, American Stars to Abdallah and his renowned son Rysdyk's Hambletonian in Orange County, N. Y., demonstrated the fact that the greatest and best results may be expected from thus breeding the light, fine, cheerful, staying, Black Hawk Morgan or Ethan Allen mare, to the larger coarser, Messenger or Bashaw, (which is almost identical, as the dam of young Bashaw, the progenitor of all the race of Bashaw trotters, was a Messenger mare,) stallion, or indeed to any coarser trotting stallion of good blood and action, as is shown by many a later performance? Even this spring I have in mind two prominent examples. Thomas Jefferson, by the larger, coarser, trotting horse Toronto Chief, dam Gipsey Queen, a fine thoroughbred Glencoe and Wagner mare, is thought to be the most promising young stallion in America, winning every race he started for last season, and but a few days since at Fleetwood in 27, 28½ and 29, and at the same meeting a six year old mare Heatherbloom, by Duke of Wellington, a large, coarse Messenger horse, out of a small thoroughbred mare called Heathbloom, owned by Mr. Griffin, of Middletown, Ct. (I have often seen her and many of her colts at his farm.) This mare, at her first appearance in the three minute class, won in 2:33, and was sold for $10,000.

These examples I have presented to show that we in Vermont, with our sturdy, little mares, can hope to produce by breeding to large, rangy, strolling stallions, as fine and valuable horses as the best, adding stride and size to their known good qualities; and I believe the day is near at hand, when this opinion will be generally adopted. The managers of

our Stock Farm are of this opinion, as is evident by the purchase of six, two stallions and four mares, from the old Mambrino Chief, Abdallah, and Bashaw crosses, and Wallkill Chief of the Hambletonian Star and Bashaw, for the improvement of horses in Vermont. This is my opinion and has for sometime been, and it was distinctively upon this opinion that I purchased Mambrino Chief, one of the best sons of the old renowned trotter, Geo. M. Patchen, (the progenitor of Lucy, Geo. M. Patchen, Jr., Godfrey's Patchen, McDonald's Patchen, Griffin's Patchen, Victor Patchen, New Jersey, Danvers Boy, Ashland Patchen, and many others,) combining Bashaw and Messenger blood by repeated strains, of whom Hiram Woodruff says: "When everything is considered, I am under the impression that Geo. M. Patchen was the best horse that Flora Temple ever contended with, and that, therefore, their names must go down linked together as those of the best mare and the best stallion that have yet appeared.

These considerations of facts, gentlemen, hastily and imperfectly made though they be, are facts, nevertheless, and warrant me in proclaiming, and I do proclaim *boldly* to the farmers and breeders of Vermont, to go on, fearless and hopefully, and breed their small but truly valuable mares to larger sized, strong boned, well bred, trotting stallions, and reach a sure and satisfactory reward. But in all conscience, never breed a little horse to a little mare; they have large strains in common, or are satisfied to breed what we are fast approximating, Mustang Kanucks, or Indian Ponies.

Mr. Douglass, of Whiting, concurred with Col. Stowell's position, that we required more size and bone in our Vermont horses, but demurred from the doctrine of large horse to small mare as a rule. Still he thought if we must breed

from small mares, large horses were required. We want no more ponies. Large and rangy mares have been sold out of this State in large numbers, and it is working our ruin. Such mares should not be sold at any price, but the temptations are great. Yet farmers who regard them must not yield to it. Let the farmers believe this, and if this Board will convince them of it, it will be doing invaluable service.

Mr. Sumner, of Brandon, objected to breeding for speed. The percentage of such is too small to make it profitable. Breeding such stock leads to a greater loss in morals than to gain in money or good horses. Still he concurred on the main question. Large mares were desirable. No ponies ought to be bred. If small mares are bred from, we must use larger horses, yet not too large, for obvious reasons. There ought to be not over one hundred pounds difference, continuing to rise as the stock increases in size, until the desired weight is reached.

Col. Merritt, of Brandon, thought Col. Stowell was not fully understood by all upon the *modes* which he proposed. He had spoken of our small mares, which will be bred from because there were so many, and he had recommended to cross them with horses like the Hambletonians, because it was the only mode to get us size and bone. He thought a man who had made this matter a life long study, as Col. Stowell had done, was qualified to teach, and should be regarded as an authority, rather than men who had never bred systematically, or made breeding a matter of science, close observation and study.

Prof. Collier briefly supported the same view. The determination of all these points depends upon scientific study of the data, and a carefully conducted and accurate record

system of experimentation. In connection with this matter, he took the opportunity to speak in commendation of Darwin's Work on the Variation of Plants and Animals under Domestication, as a valuable aid to the practical worker in farming and breeding.

Mr. Douglass, while agreeing in the main with Col. Stowell, protested against breeding for speed alone. Many of the fastest horses were worthless for anything but racing—not worth sixpence a hundred. We want facts not simply in regard to speed, but upon endurance, intelligence, docility, and general usefulness.

Col. Stowell thought he should have to read his paper over again, as it seemed to be so misunderstood. He did not advocate breeding 800 lb. mares to 1500 lb. horses, nor did he undervalue the qualities of the Morgan horse, as he was in his prime. He believed the Morgan was the result of a cross, and when it came to interbreeding there was deterioration. We want another cross, and he recommended one that would bring in size, bone, endurance and style. We have got to do this with the mares we have, and how otherwise shall it be done than upon the principles I have advocated? A cross of a 900 or a 1000 lb. mare with a 1100 or 1200 lb. horse, with bone, ranginess, and endurance, is not too violent a cross.

# MANUFACTURE OF MAPLE SUGAR.

A PAPER READ AT THE LATE MEETING OF THE STATE BOARD OF AGRICULTURE AT MONTPELIER,

BY LEANDER COBURN, ESQ., OF EAST MONTPELIER.

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After a few general remarks tending to show that in the manufacture of maple sugar, as in the manufacture of butter and cheese and other articles, the better the quality the greater the profit, Mr. Coburn proceeded with his subject as follows:

I presume there are those here who will disagree with me on some points; it would be strange if there were not, and those that do, I hope will have a chance to express their opinions, and improve the opportunity. In the first place there is but little to be said on the subject or mode of tapping the trees, for nearly all agree that it is the best way to use a small bit, ⅜ or ½ inch, to tap with, as the tree will yield as much sap, and the wound will grow over much sooner than it would to use a large bit. The metallic or tin spout is a great improvement on the old wooden spout used after the tapping iron, which cut a broad gash through the bark into the wood that took years to heal. In my father's sugar orchard there were many trees badly injured, and some were hollow, from the effect of one year's tapping with an ax. The man that commenced on and cleared up the

farm used to tap with an ax; he would cut some four or five boxes or gashes, one above the other, and then strike in his ax below these gashes and put in a spout as wide as the bit of his ax. The consequence was that in three or four years his sugar trees would be gone, and then he would move his boiling works to another place and commence with another stock of trees, which was, in my opinion, poor policy, for the longer trees are tapped the sweeter the sap becomes. This I know from my first experience in sugar making. When I was a boy I purchased one hundred sap-tubs, and commenced sugaring on my own hook, with trees that had never been tapped before, and my brother, older, sugared in what we called the old sugar place, and we found that his sap was nearly twice as sweet as mine. A neighbor had a sugar orchard lying by the side of our old sugar orchard, which had not been tapped but a part of the time, and his sap was not as sweet as ours. Therefore, from the foregoing I draw the conclusion that by continued tapping the sap becomes sweeter, but where the extreme limit is, in this direction, I know not, nor do I know that it has ever been reached.

The main points on which the quality of sugar depends are, first, the sweetness and cleanliness of the tubs and everything connected with the sugar orchard, and without this requisite no one can make the best quality of sugar. And I think that tin tubs are much better than wooden ones, for tin tubs are easier kept clean and sweet. The sap will penetrate the wood of the wooden tub, and sours and dries during the last part of sugaring; and another advantage tin has over wood is, you can gather the sap earlier in the morning from the tin tubs than you can from the wooden ones. Most of the wooden tubs are manufactured of timber embracing the sap as well as the heart timber. This sap wood sours

much quicker than the heart wood, so that heart tubs are preferable to those containing the sap wood. I notice that some use wooden tubs painted inside and out, and think them preferable to tin, as they do not warm the sap as much in a sunny day as the tin does, and will therefore keep the sap longer sweet, but the fact is that sap should not stand in any tubs any longer than one can help, and as sap can be gathered from a tin tub whenever it is warm enough for sap to run, and as sap will keep longer in bulk, if gathered when it is cold, than it will in the sap-tubs, it gives the tin tubs an advantage in this direction.

Sap should be gathered and boiled as soon as possible after it has left the trees. This is one of the main points, on which good or poor sugar depends, for the longer sap stands after it has left the tree, before it is boiled, the more color there will be in the sugar. Sap should be strained before it is boiled, to take out all foreign substances, and in boiling it, one should make it a point to syrup off quite often, as the continued boiling of the same sweet for a long time will color it, and the boiling apparatus should be constructed with special reference to this idea, and the syrup should be sugared off as soon as it has stood sufficient time to settle, and it should stand in tin cans, kept in a cool, dark place if possible. Sap commences to change as soon as it leaves the tree, and should therefore be worked up as soon as possible, and our motto should be, in making sugar, first, cleanliness, second, expeditiousness, third, to get all foreign substances out of it and put none in, either in boiling the sap or in sugaring off.

A prolonged and spirited discussion followed the reading of the paper, which was carried on by Prof. Collier, and by Messrs. Foster, Ormsby, Bisbee, Andrews, Arms, Holden, and other well known sugar makers in Washington county.

There seemed to be a variety of opinions, even among those who produce the best article of syrup and sugar, especially as to the relative merits of pans for boiling down the sap, and evaporators. Mr. Coburn, who read the paper, had always used pans, and liked them. In reply to questions, Mr. Coburn stated that he always used smallish pans, but thought evaporators possessed some advantages, especially in boiling faster and running off quickly, but were not so easily cleansed. He used galvanized iron for pans.

Mr. Bisbee thought evaporators give a different flavor and look to the sugar and syrup; still he preferred them to pans. His only objection to it was, that it cost about $90, when he thought it ought not to cost more than $30.

Mr. Andrews, of Berlin, said he was able with an evaporator to produce two hundred pounds of sugar in the same time that he could one hundred and twenty-five with pans, and that he had never been troubled in being run over with sap since he had adopted them. They required a little more care in using than pans did, but it could be afforded. He very much preferred them.

Mr. Holden and Mr. Arms, from their own experience as well as observation, rather inclined to pans, and Mr. Ormsby said he had never seen any sugar made in the evaporator that was equal to that made in pans.

All seemed to be agreed in one thing — that the sooner sap was converted into sugar after it came from the tree, the less color there would be in the sugar, and as rapidity in the manufacture was an important consideration to produce the cleanest syrup and the whitest sugar, the "evaporators" seemed to get a little ahead at this point of the case. As to spiles for tapping the trees, Mr. Bisbee did not like the

"Eureka," or Post Metallic spile, as it is called. Mr. Arms and others did; thought it much better than wood; did not plug up the hole so much; thawed out sooner in the morning, and never leaked. The question was raised as to the galvanized, or zinc-coated pans. Prof. Collier replied that zinc, which was a poison, was easily acted upon by acids, and if acids were allowed to form in the pans, the poison would to a greater or less extent be imparted to the sugar. He spoke of the importance of the sugar interest to Vermont, exceeding, as he learned from the last census statistics, that of wool.

*Letter from Mr. Harmon Northrop, of Fairfield, on "Maple Sugar Making."*

MR. NORTHROP'S LETTER.

Dear Sir:—Yours of the 18th is received, in which you solicit my help in the cause of agriculture and manufactures. The interest that I feel in the cause is the only inducement I have in attempting to write upon the subject. I will briefly state some of my views and experience in sugar making.

In order to make good sugar, the first thing I will mention is the importance of having everything perfectly clean and sweet; the sap tubs, storage tubs, pans, and everything about the premises.

My sugar house is on a hill side, dug in, and set so that I can drive up and run the sap with a spout into the store tub. Have a strainer over the top of the tub. These carry the sap by spouts to all the pans — four in number. While boiling be sure and skim off all scum that rises. I make my syrup thick enough so that two pailfuls will make one of sugar. I always strain the syrup, when taken off, into tubs, then let it settle two or three days more. Then when I go

to sugar it, I dip or pour it off carefully, not letting any of the sediment at the bottom into the syrup. In order to make good sugar it is very important to boil the sap as soon as possible after it runs, especially in the latter part of the season. Some of my neighbors are getting evaporators. I have had no experience with them. But my opinion is that they cannot make as good an article in them as can be made in pans, for this reason: it is sugared without any settling. I have never been able, as yet, to make any syrup so nice, but what there would be a black, gritty sediment, after settling for a suitable time. For this reason I prefer pans.

I think it a good plan, whenever the sap stops running for a while, to turn the buckets bottom side up until it runs again. It keeps them from souring, which is quite necessary in order to make good sugar.

Yours truly, HARMON NORTHROP.

*Fairfield, December* 22, 1871.

Following the letter was a brief discussion upon the nature of the gritty sediment from maple syrup, commonly termed "nitre." Prof. Johnson said he had analyzed it, and that it is principally malate of lime, a compound of malic acid (which exists in many plants, but is most abundant in apples,) and lime.

Mr. Heath, of Plainfield, remarked that this substance was most abundant on limestone soils. It also varied in different years. Prof. Johnson gave some facts confirmatory of the abundance of "nitre" from trees on limestone soils. He said on his father's farm, which was on limestone, they could not make white sugar, on account of this difficulty. Mr. Heath said the objection of Mr. Northrop to the Ohio Evaporator was not valid, as the "nitre" was deposited in the evaporator during the process of boiling.

*Letter from H. Allen Soule, Esq., Fairfield, Vt.. on Maple Sugar Making.*

In your report of the meeting of the Board of Agriculture, &c., held at Burlington, is a letter from my townsman, Hon. Harmon Northrop, on maple sugar making. I have had some experience in making maple sugar, and I cannot but think some of Mr. Northrop's views are erroneous, and, going to the world with the practical endorsement of the Board, must carry an influence not favorable to the best results. I therefore beg leave to present my own views and experience upon the subject.

While a boy at home we acquired the reputation of making as good sugar as anybody who sold their product in our market; and since I came to make sugar for myself, some fourteen or fifteen years ago, I have earnestly endeavored to keep up with all the improvements, and hold my position in the market as maker of an "A No. 1" article. We formerly made our sugar in kettles, but were among the first to adopt the pans so strongly recommended by Mr. Northrop, and many years ago had all the spouts and strainers he speaks of in use. We spared no pains with our product, and when we heard of improvements in methods of manufacture or in apparatus we investigated and adopted any which we found it for our interest to. We think we were among the very first to adopt the system of boiling shallow masses, and when the syphon system of Mr. Smead, of Wallingford, was introduced in that part of the State, we procured the apparatus and used it a few seasons. By this system the cold sap was all run into one pan, and being kept by the syphon connections at the same level in all, the syrup accumulated in the fourth or farthest pan. We do not hesitate to pronounce this as great an improvement upon Mr. Northrop's four pan

system, as that is upon our original kettle system. Meantime, we were investigating the action and results of "the evaporator," which Mr. Northrop so positively condemns without a trial, and notwithstanding we were fairly fitted up with all the apparatus named above, we became convinced that our interest lay in discarding it altogether and putting in "the evaporator." We, nevertheless, determined to move safely, and we took "the evaporator" only on trial the first year, but were glad to pay for it at the end of the season, and now, with all due deference to the "opinion" of our venerable townsman, we say we know we can make more and better sugar, and with less labor, and much less fuel, in the "evaporator" than by his four pan system. Mr. Northrop evidently does not understand the evaporator system of manufacture, but supposes that the sap is reduced to sugar at one operation.

We do not know that such is the practice anywhere, or that it is recommended by anybody, but of course it is possible, as it is possible for him to make sugar at one operation in his four pan system. Of course, the evaporator product in such case would be very much superior to the other, and the only serious obstacle to the practice is the presence of the substance which was spoken of in the after discussion as "nitre," although it may be a question whether, in the entire absence of that substance, it would be good economy to make the sugar at one operation. We usually let our syrup stand over night to settle, but we do not approve of letting it stand two or three days, as recommended by Mr. Northrop. It is well known that light and air both exert unfavorable influences upon sugar solutions whatever their density, and Mr. Northrop's remark about the necessity of boiling sap as soon as it runs, is true of the solution in every stage of the manufacture. The sooner it is made the more crys-

talizable sugar can be made from the sap, and the less uncrystalizable sugar drains out in the form of strong molasses. Our syrup flows from the evaporator in a small, steady stream upon a sheet of thick flannel, through which it percolates into the settling tub, leaving upon the strainer most of the substance spoken of as "nitre," the remainder of which will settle in one night as well as in one year. Unlike Mr. N., we have quite uniformly been able to make our syrup so nice that there would not be a "black, gritty sediment at the bottom after settling a suitable time," and there is just where the evaporator has an advantage, though by no means the greatest, over the pans.

But I see I am already asking too much of your space, and with a word about this "nitre" I will close. Several years ago, Mr. O. S. Bliss, of Georgia, sent samples of that substance, and two cans of sap taken from our sugar establishment, to the Chemist of the Department of Agriculture, at Washington, who pronounced the substance *tartrate of lime*, and furnished specific directions for treating the sap so as to cause its precipitation. That report was published by Mr. Bliss in several of the State papers, including your own.

# PLOWS AND PLOWING.

A PAPER READ BEFORE THE MEETING OF THE STATE BOARD OF AGRICULTURE, AT RANDOLPH, JUNE 15TH AND 16TH,

BY J. J. WASHBURN, ESQ., RANDOLPH, VT.

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One of the most attractive places which the enterprising farmer can visit are the rooms of the New York State Agricultural Society, at Albany. These rooms are arranged expressly for an extensive agricultural museum, and contain samples of all the different farm implements of the country, a great variety of specimens of farm products, besides very many relics of agriculture in "ye olden time." One of the best features of this institution is its accessibility, the doors being open to visitors at least six hours a day the year round. Among the many interesting things here exhibited, no one will fail to be impressed with the number and variety of the plows shown. The old saying, that "the plow is the greatest of all civilizers," seems to have been fully realized by inventors and manufacturers to the present day.

Agricultural savants tell us that the first plow of which we have any definite knowledge as to its mechanical construction, is found engraved on the ancient monuments of Asia Minor. It was a natural crook, with the exception of a connecting brace, extending from the share to the beam. A smaller limb, growing from the upper part of the share,

was left for a handle, while two or three small branches near the end of the beam were left apparently two or three inches long, and served for clevis, chain, staple and ring. It is supposed that with a plow like this the servants of Job "were plowing in the field when the Sabeans came upon them and drove them away;" and it is also with such a one that Ulysses plowed the sands of the shores of Ithaca, when he feigned madness before the messengers of Agamemnon. Had old Ulysses lived in more enlightened days of agriculture, he could have spared himself the pain of pretending madness, as the use of such a tool would be considered *prima facie* evidence of the fact. Later than this we find the plow of Cincinnatus and Cato; the same from the use of which Cincinnatus was called to take the dictatorship of Rome and rescue the Eternal City from the savage hordes which then besieged it. This plow consisted of a straight sole, to which two pieces of what might be termed slitwork are attached, forming an acute angle at the point; these side pieces extend back nearly as far as the sole, and a wooden pin sloping backward is driven into each near the rear end; these pins served to push away the soil as it passed the point backward, and to some extent prevented the dirt from falling back into the furrow. A long pin is set into the rear of the sole for a handle, and the beam passes from this through a standard in the front end of the sole to the team. We can imagine that, with all his modesty, the change from this rude avocation to the imperial dictatorship must have been quite pleasing to Cincinnatus, though we are informed that his love for plowing was so great, that after delivering his country from the hands of the enemy, he retired "beyond Tiber" to till the soil again.

The East Indian plow is a very interesting relic; it has one handle, a long crooked beam, and a wooden share shaped

somewhat like a wedge, pointed with iron. This plow has a remarkable history, if the records of mythology can be relied on, and its origin is said to have caused great commotion among the gods and goddesses of the mystic world; but the "family brew" was finally cleared up by one Triptolemus, who, under the inspiration of our old agricultural friend, Ceres, brought out the plow, finished and "ready to run," to the infinite rejoicing of all the other deities. This proceeding restored harmony to the celestial world. Eminent travelers state that this plow is still used in some portions of India. Not very much different from this is the plow almost universally used in Mexico at the present time; and a Chinese plow apparently of the same origin, but differing a little in construction, is also in the museum.

It seems that the first idea of a regular mouldboard was invented about the beginning of the last century, and with other improvements, such as a colter, bridle or clevis, and two handles, was called the Rotherham plow. The mouldboard was of wood, covered with sheet iron, and contained a curve, so that the soil was first raised and then slightly twisted to the right, which had a tendency to invert it. Next came the Berkshire and East Lothian plows, made almost wholly of iron, and working on the wedge principle, though in a very rude manner.

Passing from these inventions of the long ago, we come to the first cast iron plow made in America. This plow, all that is left of it, is in the museum; the whole casting is in one piece, comprising sole, standard, mouldboard and share. It acted like a very blunt wedge, entering the ground at an abrupt angle, raising the soil slightly and pushing it almost immediately to the right. This is a very interesting object. Taken in connection with subsequent improvements in plows,

it shows the march of modern invention in this very important branch of industry.

Among the many contributions to the museum of later years, are the Prouty and Mears' plow, the Holbrook Landside and Swivel plows, the Burch Swivel plow, and many other kinds interesting to the visitor for their curious construction. It seems that the first object of a plow was to stir up and pulverize the soil, but that after the invention of the mouldboard, by which the sod was inverted, this object was almost forgotten as far as the plow was concerned, and all the genius of inventors was turned toward getting up a plow that would turn better than any other, the pulverization being left for the harrow to accomplish. This had so far become the case that when a few years ago the veteran agriculturist, Solon Robinson, stated to the public that the best plow was the one that would pulverize the soil the best, he was met by a great array of arguments to prove that the prime object in plowing was to turn the soil, and this has continued to be the case with few exceptions to the present time.

Of modern inventors and improvers of the plow, perhaps Governor Holbrook, of Brattleboro, stands at the head. While seeking to perfect an implement which will thoroughly invert the soil, he has combined with it great pulverizing power, and at the same time has not forgotten that lightness of draught and ease of holding are among the valuable features of a tool so universally used as the plow. His improvements have also extended to the mechanical construction of the implement, so that those parts most subject to wear out can be cheaply renewed at any time, thereby obviating the necessity of buying new every few years. These improvements in construction, by which better work can be done with much less expenditure of power, and much

expense saved in a term of years in the matter of repairing, together with the fact that none but the best quality of new iron and well seasoned oak timber are worked into them, render it highly probable that the Holbrook plows are really the cheapest in the country; while my own experiments with this and plows of other manufacture, during the past year, have convinced me that it is far ahead of any other in the work that it can be made to do.

It is evident that the Swivel plow is preferable to the Landside if it can be made to turn as well on level land, because with it the furrows can all be turned in the same direction, avoiding dead furrows and ridges, while on side hills they are an absolute necessity. Within the past two years I have tried several different kinds of plows, and studied as carefully as possible their advantages and failings. The Birch, Hodge, and Sykes Swivel plows are all novelties in their line and do pretty good work; the Michigan Double Swivel plow does excellent business, but requires too much team for the majority of Vermont farmers. The Strickland Swivel plow, made at Bradford and Randolph, is quite extensively used in many sections of the State, and for exclusive side hill use is a good plow. What we want, and what we must all eventually have, is a plow that will work equally well on steep and level land. After repeated experiments in this branch of farming, I am content to take the Holbrook Swivel plow as the desideratum required, and use until a better shall appear.

Colonel Mead, of Randolph, expressed the opinion that there was now a great awakening among the farmers in regard to the importance and practicability of pulverizing, as well as turning the soil, in plowing. Plows that can do this are certainly and emphatically labor-saving implements.

Mr. Halbert, of Essex, stated that the Holbrook Swivel plow was coming into use extensively in Chittenden county, and was much approved. He also spoke highly of the use of the cultivator harrow for completing thorough pulverization. The kind of cultivator alluded to is known as Shares' patent.

Mr. Jameson, of Irasburgh, spoke of the excellent work of a new harrow invented by Nutting, of Randolph. The teeth of this harrow are somewhat share-shaped. They are made of spring steel; there are many of them, (forty,) and they work well. The smoothing-harrow, with teeth slanting backward, was described and commended.

Mr. G. F. Nutting, of Randolph, expressed the belief that when harrows were properly used, they did not, as generally believed, compact the soil. He advocated weighting the harrow more and more each time it goes over the field, so that the teeth may be made to penetrate more deeply. In this way he thought it would not act as a consolidator, but a thorough and deep pulverizer. He alluded more especially to harrows with share-shaped teeth. Mr. Nutting spoke at some length of the desirableness of a successful implement for potato digging, and expressed the belief that it might reasonably be looked for.

Mr. Jameson doubted the practicability of such an implement.

Dr. Hoskins thought that with clean culture it could be done.

Mr. Walbridge, of Randolph, advocated more elbow-grease in potato culture.

# THE BREEDING OF PLANTS BY HYBRIDIZATION, SELECTION, &c.

A PAPER READ AT THE MEETING OF THE BOARD OF AGRICULTURE, AT BRANDON, JUNE 8TH AND 9TH, 1871,

BY C. G. PRINGLE, ESQ., OF CHARLOTTE.

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It is an interesting fact that the wildest visions ever conceived by human fancy, those wonder tales of the East, which enchant our youth, find their parallels among the realities of our later day. Thus beneath the brush of the hybridist, as if it was the wand of a magician of olden story, spring new forms of beauty or of utility. Almost at will he calls them forth in the fullest diversity and of great excellence, till it would hardly seem too great a venture to assert that he can fill you any order for a new plant, made, of course, within reasonable limits.

To those who are familiar with the breeding of animals, I can speak intelligibly of the breeding of plants, since exactly the same laws of inheritance operate in each, and the closest parallelism exists in the methods and means of this improvement. With both this work is a course of good feeding, careful selection and judicious crossing. Animals and plants having been made for man's use or enjoyment, his intelligent hand is upon his gifts to mould and perfect them till they best serve these ends.

In a state of nature we find plants, as animals, compelled to maintain a severe struggle for existence. They are hemmed in by rivals to the soil, and exposed to the attacks of foes. Although distributed with reference to wise adaptations of soil and climate, the best conditions which they are able to secure for themselves are usually insufficient for their fullest development. Among these the cultivator selects his subjects for culture. Removing it from the hard conditions in which he finds it, he plants it in a soil made deep and mellow by tillage and abundantly supplied with plant food. He prevents the encroachment of any intruding plants, guards against the depredations of insects and other enemies, and shields it as much as possible from every unfavorable influence. The effects of such cultivation upon the wildling soon manifest themselves. The first result is a more generous growth; then through subsequent generations of seedlings, the buds, or fruits, or perhaps the roots, increase in size or value, till the patient cultivator is rewarded by a product which contributes much to his sustenance or comfort. By this slow but simple process our cultivated plants were doubtless in primitive times brought forward to usefulness from a state of almost complete worthlessness, wherein the qualities, which eventually become of the highest importance, existed only in a degree sufficient to convey to the hungry savage or to the rude and untutored husbandman the barest intimation that they might repay the meagre attentions he was able to bestow upon them. They who took the first steps in the cultivation of our corn or wheat, or our apples or grapes, wrought all unconscious of the good end they were advancing, it is probable, and were as much surprised as gratified at each improvement which a plant displayed in their hands, perhaps regarding, as we are too apt to do even in our day of wonders, wrought with plants,

each successive step taken in advance as the highest degree of excellence possible to be attained. It was by this the most primitive, though a most efficient and sure means for the improvement of plants, that the cabbage with scarcely any head, the beet, carrot, parsnip, and turnip, with roots no larger than those of the caraway, and bitter and woody at that, and the potato with tubers but little larger than a walnut, taken from their wild haunts, acquired their present perfection. Thus they become storehouses, crowded with the rich nutriment for man or beast, which they elaborate under high cultivation from a fertile soil. It is by this means alone, aided, of course, as in the other examples by selection, that the tomato, within the period of our memory, has swelled out its fruit from the size of a cherry to that of the largest apple. Recent experiments with some wild plants have obtained the same results. Prof. Buchanan, of England, by a few years of cultivation and selection, converted the wild parsnip into new and good varieties. And in France, M. M. Vilmorin and Carriere in a few years by the same means transformed the wild carrot of the fields into an eatable root.

But if high cultivation and careful selection of the most desirable form were necessary to bring our cultivated plants to their present condition of excellence, those means are still indispensable to maintain them in this condition. Their improvement has been effected by a slow and laborious process; but their degeneration if they were left to themselves would be swift and sure. Improvements in plants and improved culture of the soil are inseparably associated. The former cannot occur independent of the latter, and the latter only makes its fullest returns by means of the former. An inferior and degenerate variety of wheat on a cold, thin, and poor soil only yields five or ten bushels per acre. The

most productive variety we grow could not do much better in such conditions. But by underdraining and deep tillage and high manuring, make that same soil warm and fruitful, and again sow the same varieties. The inferior sort may now yield twenty bushels; while the other would be likely to give forty. A neighbor finds that the choice apples do not for some reason succeed in his soil, and he has been compelled to fill out the gaps in his orchard with hardier, but poor sorts, whose fruit is almost unsaleable, except at the cider-mill; but a permanent improvement, by means of under drains and manure, costing perhaps $100 per acre, would have saved his Baldwins and Greenings; and not unfrequently would they have brought him $300 a year. Another neighbor has tried the new potato at some cost, and finds, as he expected, that they are humbugs; they don't yield much more than the old sort, and they are wet and poor in quality. He finds no good thing in them; considers himself an injured man, and sighs for a potato that will yield as much and cook as well as the old Blue Noses used to do forty years ago. He maintains his grief and his perversity, although his next neighbor has learned how to grow from 300 to 400 bushels of these same new potatoes on an acre, and of such quality that they are in good demand among the best growers in town.

As a hybridist and a breeder of plants, I enter this plea for a more thorough cultivation of the soil. What avails our labor, if, after we have employed all our arts to bring a plant to perfection, after we have aroused all its energies, and have expanded and developed every inherent capability, if, then, we must pass our product to a slovenly system of agriculture, to be exposed to mean fare and neglect, what will the good we designed for agriculture or horticulture amount to? What would be the feelings of the stock

breeder should he see his most thoroughly bred Shorthorns, perfect in outline, and glossy and full from good care, transported from his fat, lowland pastures and forest, to grub their living from the cold and rocky soil of a mountainous district, or turned out of his warm stable to crouch and shiver through a January night under the leeward side of a stack or hedge? It is not at all to the credit of our husbandry, that our good varieties of grains, roots, &c., so soon "run out." Better cultivation and a more intelligent and careful selection of seed would perpetuate almost indefinitely any good race of plants. The question respecting the degeneration and ultimate decay of cultivated varieties must still remain in dispute, since so much of this deterioration must, perforce, be attributed to careless sowing of inferior seed and indifferent cultivation. The very means which brought our useful plants from the wild state are often disregarded, and they gravitate of themselves towards the lower forms from which they were raised. Against such a result a barrier must constantly be interposed.

Every good farmer selects his seed with care. He chooses for planting not only the largest ears of corn, but such of them as contain the plumpest and best set kernels. The smallest and but partially developed grains at the upper end of the ear he rejects. And who ever hears a complaint that our varieties of corn run out? Should he exercise the same care upon his sowed grain and all other seeds, he would reap the highest advantage. Several instances are on record of improved sorts of wheat, such as it were easy to persuade one were quite new, having been produced by sowing in the most favorable conditions the largest kernels of wheat secured out of the common bin. In this way every farmer may and should become a breeder of plants. This

systematic selection cannot be remitted with impunity, and it is absolutely essential to the maintenance of the excellence even of our best and most perfect varieties. This work rests with the ordinary cultivator, and this the originator of new varieties asks at his hands.

Until a recent day, *selection* has been the means chiefly depended upon in the improvement of plants, and it is not to be denied that by far the greater part of our most prized varieties of fruits, cereals, &c., have come into our possession spontaneously, as it were, appearing at rare intervals in cultivation. They owe nothing to artificial crossing in their production. When the wild plant has been sometime under the influences of cultivation, besides the change it undergoes from an enlarged growth of its parts, occasional variations from the present form (slight they may be at first) will appear among its seedlings. If the cultivator selects these variations which promise to be of some advantage, and raises seedlings from them, and so on and through several generations of the plant, he will obtain forms removed more and more widely from the original type, and possessing the desired characters in a higher and higher degree. The work of improvement advances but slowly, and the real gains are of rare occurrence. This work of improvement by selection is carried on incidentally in cultivation. In the old orchards of New England, once stood hundreds of thousands of sorts of apples. Now and again a superior sort was found among the best and was propagated. Perhaps one in ten thousand of them acquired a national reputation. In our generation the Seckel pear springs up in a pasture in Pennsylvania. In another the Sheldon appears on a farm in New York, and in our own the Clapp's Favorite is found in a fruit garden near Boston. An observing farmer notices in his wheat field a head of peculiar form; he saves its ker-

nels apart by themselves, and soon he is growing a new sort of wheat. We call these "chance seedlings," because it is only by the rarest chances that they appear, and are discovered and saved when they do appear. Fortunate, indeed, is he who finds one which possesses much merit. They are only found in cultivation, or on its borders, and are due to the variations which cultivation induces, after it has broken up the fixed habit acquired by the plant in a state of nature. But one who would set about to produce new and important varieties by raising seedlings, would assume an onerous, if not a hopeless task. Many plants vary but slightly from seed, and of those which vary much he would need to raise a thousand seedlings, perhaps, to find one of value. The large European nurseries of seedlings afford unusual advantages for this work, and the workmen, we are told, are rewarded with a bounty when they find any interesting sport. Yet it is to this slow process of selection, unconscious or methodical, aided by cultivation, that we owe almost all the value which our plants possess.

But if the variations obtained by cultivation and secured by selection are the results of exceedingly rare chances, we have in *hybridization* or *cross breeding* a most fruitful source of variation. The offspring, which result from the union of two distinct species, or of two varieties of the same species, exhibit the greatest diversity of characters. The results, which formerly by selection required a life time of patient care to produce, are now secured often in a single year. By hybridism we attack the fixed habits of a plant acquired by long exposure to uniform conditions. By opposing to its own characters and mingling with them those of a different nature, we at once completely break up its stability. Employing the numerous and diverse characters supplied in different ways and in varying proportions, the

progeny tend to assume every intermediate form between the parents, and if the work is carried further, if unions are effected among the first hybrids or crosses, if they are bred with either parent form, their offspring sport almost, it would seem at first sight, without law or limit. The wildest confusion exists among our seedlings. If they are hybrids, as we call the results of the union of two distinct species, more or less sterility may be expected among them. Some of the most promising forms will likely be utterly incapable of perpetuating themselves, and will be lost to cultivation unless they are such plants as may be propagated by cuttings, offsets, &c. But sterility is often a great gain. This is when it induces some monstrous development of the leaves, roots, tubers, &c. The plants which must result from the union of two varieties of the same species usually produce seed, but they are far from coming true from seed. Selection now comes in to our aid, and relieves us from the confusion into which the very prodigality of hybridization has thrown us. We choose such forms from amongst our numerous seedlings as give promise of value, and we practice selection on their progeny generation after generation by a fixed line of action, and with reference to a predetermined end. After a few years we succeed in fixing the character of our new plants. The laws of inheritance, interrupted by hybridization, resume their operation, and then, but not till then, (however excellent it may be,) may we safely trust our product to the hands of others.

Of course with plants propagated by cuttings, buds, offsets, tubers, &c., (and happily most plants may be so increased,) there is no necessity for this tedious process of selection. By these means the new variety may at once be extensively multiplied for dissemination, and may be perpetuated indefinitely. Swift and sure are the rewards of

him who operates upon this class of plants; but he who attempts improvements upon such as can only be continued and increased by seed, requires, besides the ever-requisite qualifications of a skillful hand and habits of close observation, those of an indomitable will and an untiring perseverance.

Though hybridism was practiced by Linnæus himself, its application to the uses of horticulture and agriculture is of but recent date. Quite at the close of the last century, Thomas Andrew Knight of England, called by Prof. Lindley "the best horticultural physiologist that the world has seen," began, by this means, the production of numerous varieties of fruits, vegetables and cereals. Coe's Golden Drop plum, and the Black Eagle and Elton cherries still remain in our choicest collection of fruits to bear witness of the success of his experiments in crossing. After Knight, hybridism made for a time but slow progress in supplying cultivation with new varieties; and, even now, the breeding of plants on systematic and scientific principles is only beginning to receive the general attention its importance demands. In Europe it has quite supplanted the old, and tedious, and less efficient methods, and it is from their intimate knowledge and diligent employment of this art that the English, French, Belgian and German horticulturists and florists produce in so short a time so astonishing results, and maintain their eminent superiority over our own. It has long been somewhat mortifying to some of us, who are sensitive from a little national pride, that we must send to Europe for our choicest flowers, as for our fashions. It was once entirely so with respect to fruits and grains, but that is fast changing now, and so it will soon be with regard to flowers. Some peculiarities of our climate,—our brighter skies and the fiercer heat of our summers,—enable us

to bring certain plants to a higher degree of perfection; to give to their flowers more brilliant and more varied colorings, than can be done beneath the leaden sky of England, or in the green-houses of Northern France or Germany. Hundreds are already taking up the hybridizing instruments, and becoming skilled by study and experiment. We have accepted the challenge of Europe, and, it is believed, we will within a few years command their respect, and receive their orders.

To refer again to achievements of foreign florists: the French and Belgian hybridists, beginning with a half dozen species of the gladiolus, have in thirty years accomplished as much for that flower as the Dutch did for the tulips by centuries of seediug. It is impossible to convey by words an idea of the extreme beauty and diversity of the choicest varieties of the gladiolus, or of the exquisite shadings and blendings of color painted by the hybridist's brush.

The azaleas, too, coming into Europe, one from India and Japan, one from the Orient, and four from America, found at Ghent distinguished amateurs, who, by judicious hybridization of the various species, produced for us one of the most brilliant plants of our collections. Foremost among those amateurs was Martin, a baker, who devoting his leisure to crossing the Oriental species with those from America, laid the foundation for all others to build upon. It is worthy of remark, in passing, that the azalea, more than once, has been successfully crossed with the rhododendron. Such a union of distinct, though probably closely related genera, has in but few instances been effected, (as when Sageret fertilized the radish with pollen of cabbage, and Wigman the English garden bean with that of the lentil.) It hints at the imperfection of our present botanical classification, which places in different genera two plants more closely related, physiologically,

than others which are included under a common specific name. For it is only between closely related species that a union can occur. The most eminent botanists or skilled hybridists have never succeeded in crossing the apple and the pear, nor the currant and the gooseberry.

But time would fail me to speak of the numerous and remarkable exploits of the English and Continental hybridists. Receiving at the hands of collectors of plants from distant corners of the earth a single species, or at most but a few species, of a plant, as the petunia from South America, the dahlia and the zinnia from Mexico, the astor from China, and the camelia from Japan: they have caused the single flowers to become double, and have endowed them with every possible beauty of form and magnificence of color.

But if hybridization is limited to closely related species, it also happens, sometimes, that we have but a single species of a plant we desire to improve. Here hybridization can avail us nothing; we have nothing with which to cross our plant. But let us not despair in such a case. Subjected to a course of liberal cultivation, our plant will in time give us some slight variation. These are to be seized upon and crossed with each other; diverse new characters will speedily appear.

I have said that hybridization was a new art, but among the flowers under my window this bright June morning are a myriad of hybridists at work, and thus they have plied their art ever since flowers bloomed and sun shone. The humming bird, lightly poising in air above each flower, his plumage glistening with gold and green, and his long beak dusky with pollen, which unwittingly he carries from flower to flower; the blustering bumble-bee, in yellow and black, stirring up the precious fertilizing dust; gaudy butterflies furnished with the most delicate brushes conceivable, and

flies and other insects of every name and degree; who shall say that nearly all these variations and sports, and chance seedlings which occur naturally, as we speak, may not be traced back to these busy operators? The adaptations provided by nature for securing the impregnation of flowers by other pollen than their own, suggest, as observation shows, the ill effects of too close or long continued interbreeding, even among plants, and hints at good results to follow from crossing. The origination of new forms is not the only good result, but increased vigor is often secured by this means for these new forms. "Andrew Knight believed that his seedlings from crossed varieties of the apple exhibited increased vigor and luxuriance, and M. Chevreul alludes to the extreme vigor of some of the crossed fruit thus raised by Sageret." "Wigman made many crosses between several varieties of cabbage; and he speaks with astonishment of the vigor and height of the mangolds, which existed to the amazement of all gardeners who beheld them." "Mr. Manuel exhibited before the Royal Agricultural Society specimens of crossed wheat, together with their purest varieties; and the editor states that they were intermediate in character, united with that greater vigor of growth which it appears, in the vegetable as in the animal world, is the result of a first cross." [DARWIN, *Variation* II., 160.] Hybridization enables us to acclimate tender foreign plants, or rather to appropriate to ourselves the excellent qualities they possess by incorporating them with our hardier native plants. So Mr. Rogers and others supplied to the harsh grapes of our woods much of the delicacy and fine flavor of the best foreign kinds.

To perform the operation of crossing, one needs a good magnifying glass, one which will distinctly reveal the grains of pollen. I find the little one called Gray's Botanical

Microscope quite efficient. Fine brushes are recommended and much used, but I find I can lodge more pollen upon the stigma by other means. I always prefer to apply a bursting anther, abundantly charged with pollen, directly to the stigma by means of pincers. These pincers are as slender as a humming-bird's bill, and furnished with springs so as to open of themselves. They are made after a French model, called there a *buxelle.* A good supply of little sacks made of fine, close paper, to be used to enclose the flower, or the whole branch on which it is situated, and shield it from the approach of insects or pollen floating in the air, is needed, and other similar sacks of gauze or loose muslin are often useful to protect the fruit from insects or birds, and preserve the seed when it falls. Such sacks may enclose a fruit or carpel, even if accompanied by leaves, the whole season through without any injury. They freely admit light, moisture and air sufficient for the fullest development of the fruit and leaves.

One must choose his subjects with care. Not only must they possess characters desirable to combine in the offspring, but they must be in a condition of the highest health and vigor. I will quote from Prof. Lecoy, a French writer on hybridization: "It is of the highest importance," says he, "to choose with care the seed-bearer and the fertilizing plant. In general the product resembles both, but I have remarked in a great number of crosses operated by myself with every possible care, that hybrids resemble the seed-bearer or mother more than their father. So, then, when one operates on fruits or vegetables, or on plants of ornament, the first care should be exercised upon the mother. However, one cannot always choose freely, because it may be that the variety preferred does not readily yield seed,

and he may be forced to choose another. In every case the choice must not be lightly made, and nothing should be left to chance. The choice of the father requires the same attentions, and when one has learned how to match plants whose good qualities and whose faults can blend, can oppose or can modify each other, he has already accomplished a good part of the work. If, for example, one wishes to improve an early fruit, he must fertilize it with a better variety, whose time of maturity approaches as near as possible to that of the first. If he seeks to obtain a fruit which will keep a long time, but which will be larger than that which he possesses, he must cross this late fruit with a finer and larger variety, whose time of ripening may also be rather late. The sugary, farinaceous, aromatic and other qualities which we meet with in our vegetables, can likewise be increased or modified by judicious crosses, as well as their size or their earliness."

To illustrate the importance of selecting plants in the highest condition of vigor, I may relate that in the summer of 1869, in producing numerous crosses among currants, I made use of a bush of the White Grape variety for one of my seed-bearers, which was not making much growth, though bearing heavily each year. Though, as in the other cases, I removed every berry except the three or four crossed ones, and stimulated the plant by high cultivation, its seedlings the next year, with one exception, attained the height of only about six inches and the size of a straw, while those raised on more vigorous bushes reached twelve inches and the size of a pipe-stem. Again, Dr. Kirtland of Ohio, a veteran horticulturist and hybridist, once informed me that the plant from which he raised his famous collection of seedling tree-pæonies was neglected one season during his absence, and that never after was he able by any care to

induce it to yield the results it had formerly done, so that he was compelled to abandon it for others.

The plants being selected, all the blooms except those designed for operation, (and those should be chosen in such situations as will insure them the fullest supply of nourishment,) should be rigorously and carefully removed, so that all the energies of the plant may be concentrated upon the production of the few seeds artificially impregnated. The flowers chosen to be operated upon must be prepared by plucking away the stamens with the buxelle some time before they are fully developed, and must be isolated in the paper bags. I prefer paper bags to those made of oiled silk, as some recommend, because they admit a circulation of air, and they are equally secure. The time when the stamens should be removed depends upon the habits of flowering peculiar to each plant. With some, the anthers burst and the stigmas are charged with pollen before the flower opens. To operate upon such plants, after this has taken place, were of course useless. With others the stamens do not mature till some time after the expansion of the corolla, but all this time the pistils have been exposed to the lodgment of foreign pollen. So for security, nearly all the flowers should be opened by hand. It is doubtless because this precautionary step is not taken, or not taken early enough, and because perfect insulation is not secured, more than from any other cause, that any uncertainty should exist about the results of hybridization. Prof. Lecoy states that most flowers require to be opened to secure their pistils from their own pollen, and grants the charge that three fourths of the new plants sold in Europe as hybrids are only natural variations.

With grapes some authorities direct that the hybridist should wait until the hood of united petals is thrown off. I

have found that the anthers begin to open their valves one or two days before this takes place, and that it is hardly possible to remove them in this condition without leaving behind on the stigma a few grains of pollen. The microscope has revealed them, and experiment has proved that they may impregnate the ovules. Therefore, the flowers of grapes must be prepared two or three days before their expansion.

With peas natural fructification is accomplished while the flowers are yet quite small and green, and the stigma of some potatoes, protruding beyond the closed petals, is exposed to chance impregnation for several days before the flower opens. True, it may not be ripe for the pollen, but the latter may be brought in contact with it, and remain in preoccupation until it is needed. I always like to occupy the stigma with pollen when preparing the flower, and often this suffices. While the stigma remains immature, the pollen lies in waiting, and when the viscid liquid issues from the depths of the stigma, it is excited into growth for the performance of its office. As it is important to charge the stigma as heavily as possible with pollen, (since a considerable amount is expended in satiating the pistil and ovarium,) it is advised to make a second application of pollen the following day. The envelops must be employed till the stigma becomes brown and dry, and when they are removed, the sacking should take their place, if necessary, to shield from injury or loss, and every cross made should be carefully ticketed. It often happens that the plants, which it is desirable to cross, do not bloom at the same time. In such cases the pollen of the earlier one may be kept till wanted for use in a dry, cool place. Pollen may be preserved without any loss of vitality for many days or even weeks. In sealed packets of sheet lead it has been kept a whole year.

The field for usefulness which opens before the hybridist is boundless. Although many flowers, as the gladiolus, tulips, &c., seem to have taken their last step, as the French say, yet others quite as promising are constantly being introduced to cultivation. These must be made double and varied indefinitely. But our useful plants, our fruits, cereals and roots, are as yet almost untouched by the hybridist. Among these almost everything of value which we possess is due to chance, and if to the chance impregnations of insects we owe so much, what may we not expect from the well calculated combinations and long sustained efforts of the intelligent breeder? Mr. Charles Arnold, of Canada, one of the most skilled and successful hybridists in America, exhibited last winter a number of crossed apples which excited considerable admiration. But in breeding grafted fruits an obstacle to success seems to be interposed in the evil influence of the natural stock, on which they are worked; as Mr. Arnold writes me that he experiences so much discouragement, (to be attributed, as he thinks, to this cause,) he is tempted to remit his experiments with apples. Since the new Clapp's Favorite pear is thought to be a natural cross between the Bartlett and the Flemish Beauty, the crossing of pears will receive a new impulse in this country. Chief among those who are engaged upon this fruit in England, is the renowned Thomas Rivers.

We ransack the earth for our new cereals, but only a few of them do we acclimate with success. By crossing we may originate them to infinity at home. The long course of selection required to fix the character of the new seedling is the only difficult part of the work. Hybrid varieties of course are now brought out almost yearly, and often, (as in the Judson Branching corn,) before they have acquired a fixed habit of selection. "A hybrid variety of corn has

proved constant and excellent for years on the home soil. When removed, however, and coming under different influences of soil and climate, it is liable the first and second year to break up into its original forms or something like them; the ears being quite variegated. After a while the tendency ceases, and the variety may then, and not till then, be considered established."—*American Agriculturist*, 1869, page 245. The same thing occurred during the last peculiar season with Mr. Arnold's cross-bred wheat, a variety displaying so many distinct forms, that, as he writes, had he not known positively that it was the product of a single kernel, he "should have thought there were several varieties of wheat mixed together." In the *second* and *third* generations of the crosses or hybrids no better results can be expected. Last year, among a large number of crossed seedlings between the Gen. Grant and the Keyes tomatoes, on my own ground, the greatest uniformity prevailed; the foliage of all resembled that of the Gen. Grant. This year many of their offspring have the broad leaf of the mother form.

With our half dozen species of native grapes to build upon, and especially with the great advances already made by chance seeding, cultivation and crossing, the possible perfection to which this fruit may be carried in this country lies far beyond our wildest dreams. So, too, of our gooseberries, of which we have four wild species. So many have the English produced from a single species, that the lists of the Lancashire nurserymen have included 200 named kinds. Among flowers none ever offered a more inviting field than does the lily at the present time. Out of Japan have not yet ceased to come wonders, and every quarter of the globe sends its peculiar species. From the blending of these,—and the work is well begun,—shall come such matchless

grace, and beauty, and fragrance, as shall forever enthrone the lily, queen of flowers.

The potato, because the results are immediate, and because of its high importance as a staple crop, offers the hybridist a most inviting field for experiment. The belief, that some advantage might still follow from continuing the course of seeding so correctly laid out by Mr. Goodrich and successfully followed up by Mr. Brezee, prompted me to undertake the crossing of the Early Rose with several other good sorts. To raise seedlings from that variety artificial impregnation is necessary, unless dependence be placed upon the chance offices of the insects, by reason of its sterility induced by abortion of its pollen, a result I have attributed to the abruptly changed conditions of life affecting its parents, or to crossing. I performed the operation of crossing in the summer of 1869, and about the 20th of April, 1870, sowed my seed in a hot bed. The last of May following, the plants, some eighty in number, were transplanted to rows in a potato field, and set about two feet apart in the rows. No manure was used in preparing the soil, as it had been enriched the previous year, and the plants only received, in common with the rest of the field, a dressing of ashes and plaster. For a while the plants held a doubtful struggle with the drouth, but eventually they reached full development, showing blossom-buds, though these were blasted by the heat. The vines presented every diversity of form, size and color; some were dwarfish and only attained the height of ten inches, while others branching fully spread two or three feet in every direction. The entire habit of some was similar to that of the Early Rose, while others resembled their male parents. But every intermediate form was exhibited. The dwarfs began to ripen their tops August 10th, (sometime before the Early Rose turned

yellow,) and they yielded from one to two pounds. These were found among the crosses with early sorts, as the Sebec. Their product was doubtless much lessened by the severe drouth of the season, since the standard early sorts were but a light crop. Those ripening through September, averaged between two and three pounds. In the early part of October, four pounds was sometimes attained, and by the 15th, more than five was not uncommon. On the night of the 27th of October the vines of those that remained (mostly crosses with late kinds, as Excelsior and White Peach Blow,) were cut down by frost. Some of these plants yielded six pounds and upwards, and the product of one was seven pounds seven ounces. The tubers were generally quite uniform in size and shape; several exceeded a pound each, and the largest one in the lot weighed twenty ounces. In adjoining rows the Early Rose averaged 2 lbs. 5 oz. Several hills of Sebec ranged from 10 oz. to 2 lbs. 3 oz.; of White Peach Blow, from 2 lbs. 15 oz. to 5 lbs. 14 oz.; and of Peerless, from 4 lbs. 2 oz. to 5 lbs. 5 oz.

It has afforded me much interest, while critically examining the offspring of these four different crosses, Sebec, White Peach Blow, and Black Mercer, each worked on the Early Rose, to observe the operation of the laws of inheritance in cross-breeding, and to trace back to its parents the several characters of each variety. For this I was almost invariably able to do. I am now prepared by this experience, as well as by some others of late, to attribute a higher importance than my reading had led me to do, to the influence of the male parent, and in future must select my pollen with even greater care. The characters of these seedlings may, in general terms, be said to be intermediate between those of the two parents. Yet, it sometimes happened in a family of seedlings, that the father and the mother were exactly re-

produced. Between these extremes, however, it would seem as though every possible gradation were occupied, as the various characters of both parents mingled in varying proportions. It would seem that the different characters of the parents had been separated from the original combinations, and having been shaken together in a common, promiscuous whole, that then that mass had been called to supply material, just as chanced to come, for each new form. Thus one of the new varieties has some of the characters of one parent blended with some derived from the other one. But this illustration is not complete till we suppose each original character to have been composed of an infinite number of units, (and those capable of self-multiplication, too,) for its reappearance in the progeny was accompanied with great modifications in degree. Sometimes the characters reappeared, aggravated or intensified to the fullest extent. For instance, the light tinge of red of the Early Rose, which shows deeper red in small, immature tubers, and often enters the flesh in faint crimson streaks, in a few of the seedlings displayed on the surface as deep rose, and pervaded the flesh as a blaze of crimson. The even surface of the Early Rose proved a prepotent character, and impressed some varieties so strongly that their surfaces were almost as free from indentations as an egg. The faint streaks of purple about the eyes of the Sebec came, in some of its descendants, to cover the whole tuber with the deepest purple or black, rendering valueless some of the earliest and otherwise most promising sorts. The deep eyes of the Sebec were sometimes sunk still deeper, so that, from the deleterious influence of these two characters, (and in the Sebec itself they are not so prominent as to detract much from its value,) I was compelled to reject nearly all its seedlings.

Nor were those characters which might be supposed to be less positive without their influence; as when the bars of white on the Black Mercer gave two white seedlings to one purple one. In the case of these Mercer seedlings, it would seem that the colors of the Mercer were separate, the units of each, (if we may so speak,) having a greater affinity for each other than for those of the opposite kind, refusing to blend again. The plants as well as the tubers presented illustrations of the principle, that crossing favors extreme variability. Some were much more dwarf than the Early Rose; others spread wider than the Excelsior. The leaflets of the Excelsior are of moderate breadth; some of its seedlings bore those in shape like an ash leaf. Those of one variety advanced so much from the broad leaves of the Early Rose as to resemble the broad and deeply netted foliage of the garden raspberry.

But the instances mentioned were exceptions to the law which ruled in general. Usually the dissimilar characters of the two parents become intimately commingled in forming the same part in the offspring, so that the latter was intermediate between those from which it was supplied. Very seldom was it evenly balanced between the two, but it resembled both, and departed from one by as much as it neared the other. Quite promising were a few varieties where the most valued qualities of both parents were united in the new plant in just proportions.

The fact that the slight faults of the Sebec,—its sunken eyes and its blotches of purple,—caused the rejection of four-fifths of its progeny, while the seedlings of the Excelsior, a white and smoother sort, were almost free from faults of color or form, illustrates the advantage which judicious crossing holds over the raising of seedlings at hap-hazard. The farmer, able to foresee to a great extent the influence

which the known characters of the parent will exert upon the character of the offspring, possesses the power of selecting the parents. But the full parentage of seeds, impregnated naturally by the instrumentality of insects, &c., must remain unknown. It is more likely to be of inferior strain than otherwise. Both methods are exposed, it is true, to the chances of reversion to inferior antecedents, and equally so, for against this there is no defense; but it is in the the power of the hybridist to shield his work from unfavorable surrounding influences, which are far more to be avoided than the tendency to reversion.

Though hybridization is beset with difficulties, and exposed to disappointments and discouragements, though its practice demands the exercise of the greatest patience and perseverance, there is a charm in moulding, sometimes almost at will, the plastic forms of plants, and in feeling, not irreverently, that the Author of Nature permits us to continue, in some sense, the work from which He rested on the evening of the third day. There is a fascination in watching the development of our creations, in tracing their characters, in seeing their opening blooms, and in tasting their ripening fruits.

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Though of greater length than most of the papers read before the board, it was listened to with the closest interest and attention throughout.

At the close of the reading of the paper, Mr. Jameson, of Irasburgh, spoke of the importance and justice of appropriations by government to properly compensate gentlemen, who, like Mr. Prindle, were spending so much of their time and means to obtain varieties and results that were of so much substantial benefit to the country. Mr. Jameson was succeeded by other gentlemen present, who testified to the desirability and justice of such appropriations.

# ADVANTAGES OF BEE-KEEPING.

A PAPER READ AT THE MEETING OF THE VERMONT STATE BOARD OF AGRICULTURE, AT ST. ALBANS,

BY O. C. WAIT, OF GEORGIA, VT.

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I am aware that my subject is very unpopular in Vermont; that many of our staunch farmers, born and bred to their employment, wonder if bee-keeping can be made a paying business. Others are so prejudiced by the force of paternal example and habit, that they have no patience to listen to this or any other subject not included in their father's creed, and taught them in their youth. Some, no doubt, would gladly, (in a good-natured way,) advise us to follow the example of the preacher, who announced as the subject of his discourse, "The world, the flesh, and the devil." He propposed to just notice the world, pass over the flesh, and hasten to the devil. I prefer a little different course, and propose to glance at some of the features of bee-keeping, pass others without a notice, and present for your careful consideration only the most interesting of those which are seldom presented to our view.

In a paper read before this board at Burlington, I mentioned the fact that the rural population of Vermont generally are obliged to earn their money by the sweat of the brow, and as a rule prosper just in proportion to the amount of intelligent labor bestowed. That though long and eagerly

sought, no easy way, adapted to the community, to make fortunes or even a comfortable maintenance, has been discovered. We have only one alternative, that of selecting from all the rural pursuits such as make available to the greatest extent the bounties of nature.

With this view, bee-keeping is recommended to a greater or less extent, according to the tastes and conditions of the inhabitants. We suggested that fear was unnecessary, for even the most timid might learn to handle bees with impunity; that this employment invariably created a deeper interest in nature than any other department in agriculture. I am aware that it is not, strictly speaking, "agriculture," but it seems fitly connected with it. We remarked that science had greatly improved its pecuniary attractions; the honey extractor enabling us to to take double the amount of honey wituout injuring the bees, or leaving one card less of comb in the hives. It is estimated that every pound of comb built by the bees involves the sacrifice of 25 or 30 pounds of honey. Ten good colonies in the best of the season will not only earn more than the daily wages of ten good farm laborers, but they will work for nothing and board themselves. We remarked that although honey sold much higher than sugar, it really costs much less. That if gathered, basswood or linden trees furnish twice, or even thrice as much honey as maples do of sugar. That Vermont bee-keepers have not learned the value of assemblages like this, nor of books and periodicals devoted to our science, consequently we are behind other states. We noticed the special adaptation of bee-keeping to the wants of those who, by declining age, misfortune or disease, are disqualified for hard labor or exposure. Also that the poor man may produce more pounds of honey than his wealthy neighbor can of sugar. It is also adapted to the wants of the ladies; they are

even excelling the "lords of creation" in gathering this "balm of a thousand flowers." I remarked that there is no luck or fatality in handling bees; that scientific care will tell favorably, while if managed by those ignorant of their natures and wants, eventual loss and disappointment is sure to follow. We suggest that bee-keeping, when stripped of its mysteries and superstitions, will become as common as in Prussia and the German States, and honey so plenty, (as in some parts of California,) that it may be in common use even among the poorer class; and so cheap that rogues will not find it for their interest to adulterate it; and that, with accumulated knowledge and increased facilities, its production will still be as profitable as now.

Pardon me if I am specific in my details; I mean to be so. The vague and indefinite character of many of our written instructions is a serious obstacle to successful practice, and frequently destroys their practical utility. The smallest wheels in a watch are just as necessary to its successful operation as the larger ones. According to the experiments of a scientific German bee-keeper, a colony of bees weighing 5 pounds, taken from the hive while lying out, number 28,000, or 5,600 to the pound, or when filled with honey preparatory to swarming, only 3,600. Of this 28,000 one only is a queen, or more properly called a mother bee; 22 to 24,000 are workers, or imperfectly developed females; the remainder are male bees, or drones. The queen originates in an ordinary worker egg laid in a queen cell, or carried there by the workers.

When suddenly deprived of their queen, they select a worker larva a few days old, tear away the surrounding cells, destroying their tiny occupants; then in an incredibly short time construct a queen cell, occupying with its thick walls the entire space of three of the cells destroyed.

This cell resembles a peanut in form, and frequently in color, as it projects half its length beyond the surrounding cells. The undisturbed larva lies coiled in the bottom of the cell, surrounded by a little transparent liquid food. This is now changed, and a much larger quantity of "royal jelly" substituted. This jelly is prepared in the stomachs of the workers, has a white porcelain-like appearance, and is wonderfully adapted to the rapid development of the embryo queen. In ordinary cases the egg hatches the third day, the larva queen remains in the uncapped cell 5 or 5½ days, and then occupies one day in weaving around herself a thin, strong cocoon. The cell is immediately capped by the bees, after which the queen remains about 2½ days in the larva state. Then commences a change, and the larva is rapidly transformed into nymph or pupa. She develops rapidly, and in about 4½ days removes the covering and emerges from her cell, a perfect queen. It is worthy of remark that while the queen requires only 15 or 16 days from the laying of the egg to the hatching from the cell, the worker requires about 4 days, and the drone 8 or 9 days longer, for the same process. This remarkable difference is all attributable to the different food provided, for all other circumstances are exactly equal.

About the fifth day after hatching, if pleasant, the young queen may be seen flying from the hive backwards, and for the first time taking a thorough survey of its front, apparently making a note of its surroundings. In this she displays, if not reasoning faculties, a high order of instinct that would do honor to some of the human race; for if like some of us she were to rush heedlessly out, she would on her return quite likely fail to find her home, and if so, would certainly be destroyed by the first colony with which she comes in contact. Usually within forty-eight hours after

this flight she commences laying eggs, providing that food and worker-comb are abundant. In her prime she is capable in some cases of laying as many as three thousand eggs per day. She seldom lays more than one egg in a cell; and rarely fails to deposit the worker eggs in the small, or worker cells, and the drone eggs in the larger, or drone cells; although these two classes may be so irregularly arranged, that her sons and daughters are promiscuously mixed.

The queen's natural vitality and longevity are so great, that she is enabled to continue these maternal duties during most of the time for several years. In the meanwhile from twelve to twenty generations of her sons and daughters have lived their allotted time and passed away. Thus we see that one queen may be, and often is, the mother of five hundred and sixty thousand bees. Her powers of reproduction are such, that she may accomplish all this without leaving the hive or associating with the other sex after the first flight, five or six years previous.

Queens have a mortal hatred towards each other; unless restrained by the workers, one of them embraces the first opportunity of biting holes in the cells and stinging her defenceless, unhatched sisters to death. If, by reason of the swarming impulse in the bees, they succeed in protecting the royal children, the older queen, baffled in her murderous plans, manifests her rage by uttering a loud note of anger, and quits the field; embracing the first opportunity to lead off a new colony. It very frequently occurs that queens get into the wrong hive; in this case the reigning queen soon scents her rival, and thrusting aside her workers, rushes to mortal combat. Each grasps the other, and a desperate succession of throes and somersaults, too rapid for the eye to follow, continues until one receives a fatal thrust

between the folds of her natural armor. The conquering queen, unlike other bees, withdraws her sting; consequently she "lives to fight another day." It is worthy of remark here that a queen may be forcibly restrained by the workers from killing the young queens, or even be torn in pieces by the human hand, without deigning to use her sting, as though "none but a royal foe were worthy of her steel." It is an unusually interesting sight to see a queen, serene and composed, yet with a royal bearing, pursuing her maternal duties. Her presence seems to be necessary to the full enjoyment of her happy family: her disappearance creates the wildest alarm and commotion in the hive, until the workers, becoming resigned to their loss, construct perhaps a score of new cells, and rear successors in the manner I have described.

Having given a minute history of the queen, I will present briefly for your consideration some of the claims honey bees have on us for our attention and fostering care. For 3,800 years the history of the honey bee has been intimately connected with that of the human race. During all this long period their products have been eagerly sought and appreciated. In answer to an inquiry, Rev. L. A. Dunn (noted for his travels in the old world) said, that in spite of their inveterate enemies, the Arabs, honey bees still exist in Palestine, but are confined to the crevices and fissures of the rocks. So we see that descendants of the bees which gathered food for John the Baptist, the forerunner of the Saviour, also that of which He ate, have lived in Palestine more than 1800 years. Another reverend gentleman says that since bees have formed so prominent a link in the chain of man's redemption, we should encourage their culture. Since we are not Arabs, let us at least avoid their barbarous practices, and destroy no more of our little friends. They

have a claim for our care and protection, in view of their wonderful adaptation to our wants. They are a sure and effective agent in the hand of a kind Providence to make available one of Nature's best and most profuse bounties, which must otherwise be lost to man. They should interest us, because through their works, more than those of all other animals, we are led to look beyond the creation with wonder and adoration to Him who created all things. And though bees are not made in His image, like man, yet in industry, neatness, order, punctuality, economy and temperance, most of God's images may well imitate their example.

It is generally supposed that a colony of bees is governed by an absolute monarchy, but in her family government the queen exercises no imperial power, and there is not the slightest resemblance to a monarchy, except that kingdoms and empires are occasionally ruled by the gentler sex; while republics usually select a governor from the sterner one.

If not in this, certainly in every other respect the government of a colony of bees is a more perfect republic than ever did or ever will exist among men; one in which each member quietly takes the place allotted by virtue of age, which is the principal qualification regarded. As soon as hatched, or within six hours, the young bee commences her life of toil by administering to the wants of the young uncapped larvæ, and with others of her age supplies the puny ones with pollen, honey, and water. In a few days the younger children relieve them of their duties as nurses, and they turn their attention to comb building, if in its season. I would notice here that the comb made by a bee six days old, and even the first cell made by a young bee, is just as perfect as the last made by an old one; all are perfect, and have been so since the creation.

After a few flights when seven or eight days old, they are

qualified to commence the labors of the season, and may be seen returning from Nature's storehouse heavily laden with pellets of pollen for the young, and sacks filled with honey from the flowers or honey dew; or acting as sentinels, stationed at the entrance as a guard, and if the weather be warm, patroling the front of the castle continually, for bees in the working season are not satisfied with ten hours labor, but work incessantly day and night during the entire honey season, or until over work or accident finishes their short career, which is usually, in a favorable time for honey gathering, only about thirty days.

When a peculiar trumpet-like sound of the sentinel or returning laborer is heard, denoting the approach of an enemy, a company of one accord sally forth to war for the common interest of the colony. Each seems to vie with his fellow in feats of daring and danger; and if possible unhesitatingly thrusts his barbed arrow, with poisoned tip, to the heart of its enemy, if an insect, or if human she usually darts her little javelin at the eye with accurate aim. Thus thousands of them "without fear of punishment or hope of reward" yield themselves willing martyrs in the defence of their homes and domestic institutions.

In their civil government there are no intriguing politicians, no Indian agents, and no hangers on around the public treasury. All alike willingly perform their duties, always working if there is work to do, and cheerfully enjoying in common the benefits. In their armies there are no skedaddlers, no jealousies, no government contractors, and certainly no cowards. But alas! through some unholy influence, or fiendish agency, they, having imbibed one human trait, occasionally depart from the path of rectitude, and, conscious of their own strength and the weakness of an adjoining colony, assume the offensive, marshal their hosts,

and if possible conquer them by slaying thousands of their own kind, in which case they not only take all the accumulated stores, but carry away captive all the survivors of the conquered colony. A colony of bees, when once demoralized in this manner, will never, unless compelled by necessity, return to habits of legitimate labor until the iniquitous generation has passed away.

There is one class of bees that we have failed to notice—the gentlemen loafers of the hive, or drones—and why should we notice them? They have no merits to plead, and as far as their labor is concerned, we may well wonder why they were made. They are careful not to be born until warm weather, (though that matter may not be under their control); then they emerge from their cells, large robust fellows, and commence a life of ease and luxury in the hive. Their very presence must be hateful to the hard-working and care-worn members of the colony. Imagine them leisurely viewing the thousands of young in the nursery, or scanning the accumulating stores of pollen and honey, saying to their better halves, "Behold what *we* have done." See them sallying forth at noonday to enjoy the sunlight and air, but always returning at nightfall, empty-handed and open-mouthed, ready to consume the hard-earned stores of their companions, for with all their faults they never keep late hours.

Thus they live on the fat of the land, supported by the workers unless supplies chance to fail so as to endanger the lives of the little ones. This arouses the sterner natures of the workers, who, resolving to tolerate the nuisance no longer, commence a war of extermination, and slay the drones by thousands. In this slaughter they will not tolerate a single drone in the wigwam; they even drag the little pale faces from the capped cells. If not before, the work-

ers are sure, at the approach of winter, to commence this slaughter, though in a milder manner, by dragging or driving the drones outside of the well-guarded door, and sternly refusing to listen to their appeals for admittance. Thus the outcasts wander from hive to hive, but everywhere finding this feminine but effective vigilance committee on the alert, and none so weak as to sell or violate justice. The poor culprits are doomed to reap what they have sown, to be gnawed by hunger and frozen by the merciless winds. I may say that by cutting out nearly all the drone comb in the hive, the raising of many drones is prevented, thereby adding to the surplus honey all they would have consumed, frequently twenty-five or thirty per cent. of the entire profit.

It is believed by many that bees injure fruit and grain in gathering honey from the flowers. Since that opinion is entertained, it becomes us to treat it with becoming consideration. But a little careful investigation on the part of the inquirer would serve to banish this superstition. Though often asserted, we never saw or heard any proof of its correctness, but on the contrary, we believe that every fruit-grower or even farmer should keep a few colonies for the more perfect fertilization of fruit and grain. There are times when the season and all the conditions, as far as we can judge, are favorable for a bountiful crop of grain at the time of blossoming, but for some generally unknown cause the crop is nearly a total failure in many localities. Now this is more frequently occasioned by the peculiar humid condition of the atmosphere than any other cause, which, with the rains, fogs, dews, and the stillness of the air, confine the pollen that would otherwise be wafted by the dry winds to the pistils of the unfertilized flowers. Under these circumstances, which are of frequent occurrence, Providence has provided only one sure remedy, and that is the carrying

of the pollen from flower to flower by insects, and the amount of crops is just in proportion to their numbers and the frequency of their visits.

It is obvious to every observing apiarian that, in such seasons as we have described, there is usually an abundance of fruit in the immediate vicinity of the apiary, where every particle of honey is eagerly sought and gathered. But in localities remote from apiaries, all other circumstances being equal, there is comparatively little fruit. The buckwheat and clover field, that furnishes the most honey, invariably produces the most seed, if the season continues favorable. It would seem to require but ordinary discernment to see that Providence did not make the honey in the blossom to be dried by the noonday sun, or washed off by the spring showers, but that on the contrary it has provided that we have all we choose to gather, at the same time accomplishing an object of much more importance, the fertilization of the fruit and grain.

In regard to the profit of bee-keeping, we might give our own experience, but prefer giving that of others. In looking over the report of the American Bee-Keepers' Association meeting at Cincinnati, I was led to arrange the following facts for the consideration of this meeting, as positive evidence of my position that bee-keeping does pay, not only six per cent. or less, like other occupations, but, fairly managed, pays a sum equal to all the capital invested, and even more, after deducting interest and expenses. We take, for instance, all the full reports of those present who had over nineteen colonies of bees in the spring, numbering forty in all. The united number of colonies was 4916, of which 2,777 were wintered, and 2,139 were the increase of the past season. The amount of honey gathered was 134,212 lbs., which sold at an average of about 29 cents per pound.

The products were, as might be expected, exceedingly variable. Bad locations, severe droughts, rearing queens and multiplying colonies rapidly for sale. all reduced the amount of honey seriously from some large apiaries, but we include the failures as well as successes. The smallest quantity reported was five pounds per colony, from Ohio. The largest, J. W. Hosmer, of Minnesota, was 253½ pounds of extracted honey from each hive. This report, though unprecedented and startling, is from a man of known integrity, and far advanced in both practical and scientific knowledge of bee-culture, while living as he does on the margin of an immense basswood forest, he has very extra facilities.

Now, recollecting a remark of General Washington, that it is advisable as far as possible to avoid telling a truth even that seemed incredible, I had decided to deal it out in homeopathic doses, until we toned up the public mind to bear larger ones. But in this you see I have failed, reminding one of the negro who said to his master, "One of your oxen is dead; the other, too; I durstn't tell you both at a time, for fear you couldn't bore it." Now, like this negro, I may as well tell the whole truth, so let us continue our investigation. 2,777 colonies divided by 40 would give 69 old colonies to each person. The average amount of honey would be 48¼ lbs. from each colony, 3315 lbs. for each bee-keeper, which, at 29 cents per pound, would amount to $971.35 for honey alone; 53½ young colonies at $5 each (exclusive of hives,) would amount to $263.50, which, with about $20 for wax sold, would make $283.50, an ample compensation for the labor and incidentals, aside from permanent fixtures, which are a part of the investment upon which we are to compute the interest. As an investment, we have 69 prime colonies at $8 each, hives included, $552; honey extractor, room for wintering, &c., $48; making in all $600 invested.

Receipts for honey $971.35, which, after deducting 12 per cent. ($71.35) interest and taxes, leaves $900, or 150 per cent. net profit. All this is saved from Nature's waste, and added to our regular income.

More than 3000 years the little busy bee has suffered the grossest injustice at our hands, though she had labored patiently all the while for the best interests of humanity. What if she has endeavored to make her power known and her presence felt by occasionally inflicting a sting? She has not after all avenged half her wrongs. Public opinion is perverted. Bee-keeping has been considered insignificant and uncertain, and those who have been investigating and practicing the science have been called infatuated. But increased familiarity with the facts of the case will speedily dispel these prejudices. It is easy, legitimate, honorable, fascinating, ennobling and almost inspiring. I might safely challenge this entire meeting, or any member of it, to point out any other employment, equal in its adaptation to our wants and means, which will pay one-half the net profit that may be and is derived from bee-keeping. Vermont has near 250 towns, containing about 200 farms each. If each of the towns would even collect what I have shown forty families might easily do, it would add to the profit of each town $38,454, and to that of the State $9,613,500 at the present prices, or even at one-half the present price it would amount to $4,806,750, which is more than the grand list of five counties like ours. It is enough, if divided, to give every man, woman, and child in this State an annual income of thirteen dollars, or any family of eight persons the yearly interest of $1,734. We are unavoidably led to the conclusion that no government bonds, bank or railroad stocks, no estates, either real or personal, no dairying or sheep husbandry, no stock raising, be it native, Alderney, Ayrshire,

or Durham, will for the labor bestowed and capital invested, give such rich returns in money. Now we may have all this every season, as Mr. Quimby says, "not for the asking, for it is already bestowed, but for the taking." Would it not be wise to make arrangements to take it?

Mr. A. Fisher, of St. Albans, had not been successful in bee-keeping with the patent hives.

Mr. Wait said he netted $21 on each of his colonies last year. Regarded the Alsike clover as the best honey plant.

Dr. Hoskins referred to the experience of Mr. J. E. Crane, of Bridport, whose father objected to his fooling away his time in keeping bees, but who, after a little while, produced a greater income from them than all the rest of the farm besides.

Mr. Lane, of Cornwall, asked how many colonies could be profitably kept in one town; thought we might overstock.

Mr. Wait said that $25,000 worth of honey had been made on 25 square miles in New York, and the territory was still not fully stocked.

# THE WEEDS OF VERMONT.

A PAPER READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, HELD AT NEWPORT, AUGUST 6TH AND 7TH, 1872,

BY C. G. PRINGLE, ESQ., OF CHARLOTTE.

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Into the discussion on good husbandry which engages our Board of Agriculture, I bring the subject of Weeds. It is quite like actual farm experience, that among so much good grain as we have here there should spring up something weedy. May not the fact that this has not sooner been the case afford evidence that our Board has farmed well? But weeds may not be ignored—not in a weedy season like the present one, when the heavens have daily dropped fatness, and the sun has not long withheld his most generous blessing, and all, you might think, from special favor of the weeds, so wonderfully have they luxuriated under these influences—not when, through all the weeks of summer, they have engaged full half our energies, as we have toiled early and late, rising up early to find them choking our choicest plants, and returning from the field late in the evening in full consciousness that they were still lurking, seen or unseen, everywhere around. So, while others may dwell upon nobler themes, it seems to fall upon me, if the whole truth about farming must be told, to make confession of weeds.

In the rudest state of nature, when man is a savage and all plants are wild, there are no weeds in an agricultural sense.

Then, if not of equal might, all plants have equal rights. In the struggle which then goes on amongst them for life and place they take precedence according to no scale of values, and even their capabilities are unrecognized. They seek their respective habitats, and arrange themselves in the various conditions of climate, soil, exposure, etc., according to their peculiar adaptations; and when the wild fruit or grain, from which the savage gathers a mean support, finds itself crowded upon by plants which may be perfectly useless to man and beast, it can hardly expect succor from him whom it feeds. But, when man has come to the goodly estate of husbandman, and has brought along with him a selection of useful plants, greatly improved like himself, he seeks out a choice soil, fences it against intrusion, renders it mellow and productive by tillage, and plants therein each sort of seeds by itself. All useless intruders upon this cultivation the farmer calls weeds. So, the old definition of a weed—" A plant out of place"—is, with him, a correct one. According to this definition, not only are those plants, possessing little or no value, which intrude among crops, properly called weeds, (such in agriculture are always and everywhere weeds,) but the scattering wheat or rye that appears amongst the corn that follows these crops, the buckwheat, self-sown the fall before, that whitens the oat field in June, the choicest grasses that spring up in the vegetable or flower garden,—all such plants, out of the place assigned them, assume the character of troublesome weeds. But the botanist, except in deference to agriculture, acknowledges no weeds. To him every plant, whether it possesses any economic value or not, is, in its peculiar and marvelous structure, an object of interest.

Now, from what a host does the partiality of the farmer for his few improved plants invite attack! Ten weeds press

upon one useful plant, thronging upon it on all sides. To subdue these, or hold them in check, requires a large share of the labor of cultivation. They infest pasture and meadow with their bitter or noxious qualities. Our sowed grain they rob of a considerable part of the fertility of the soil in all ordinary farming, and among our hoed crops it is the same, unless they are faithfully extirpated at much cost. How diversified in character and habits are these foes of the farmer. The tiny mouse-ear blooms beneath the snows of spring. The pigweed attains the height of a man in a few weeks, and sheds its seeds in the autumn frosts. Between these extremes what variations of size and form and season. There are weeds for the meadow and weeds for the pasture; weeds for the grainfield and cornfield, for the door-yard and the barn-yard, and weeds which most affect the garden. There are weeds for dry ground, and weeds for wet places; weeds for every month of the summer, and weeds for the whole summer; annuals and perennials. How abundantly endowed with resources for maintaining the contest. What powers of reproduction. The wild mustard has been known to ripen eight thousand seeds, and the corn cockle twenty-five hundred. And what ability to adapt themselves to different conditions of soil or season. The green amaranth or red root, when it springs up after cultivation is over, near the end of summer, will, in the few weeks that remain before frost, fully perfect its seeds. But in doing so it fully understands what it is about, and does not undertake a growth of five feet, as it would have done early in the season, or in a fat soil. It puts forth but a few tiny leaves, and its stature may not exceed a single inch. There are many weeds that accommodate themselves to circumstances as readily as this one does. But this pliability of constitution is not shared, in any considerable degree, by our cultivated plants. They re-

quire, for their full development, a definite period of time and quite definite amounts of heat and food. It is but recently that the important part in the remarkable perpetuation of plants in the soil, which is borne by these insignificant growths, maintained by plants in adverse circumstances, as in sod or grain-fields, and often escaping notice, has been fully observed. Nevertheless it remains true that dormant seeds, as much as any other resource of weeds, defeat the farmer's endeavor toward clean tillage. Buried deep in the earth by the plow, they may preserve their vitality for many years; and, when the soil is deeply stirred again, and they are brought under the influence of the warmth and the air of the surface, they may start into life, and cover the ground with a motly herbage, to the astonishment of the farmer, who may have accounted his soil clean of weeds.

Happily, in our war with weeds, we may avail ourselves of well approved tactics, and head off our enemy by certain short cuts. First, we should move upon their works in an early campaign, before they have become firmly established in their position. Shortly after planting has been done, the seeds of weeds lying near the surface for the most part germinate. Those of a few species wait for the heat of summer to bring them out, and such, mingling with those of the early growing sorts which at first lay too deep to grow, will give trouble later in the season, sometimes even after cultivation can no longer be carried on without injury to the crop. But the main crop of weeds starts with corn, and an early stirring of the surface in dry weather will readily destroy them. If this be done before the plants appear above the ground, all the better, for their tiny and tender stems are then most easily broken by a movement of the soil. During the first week or ten days of their life the difficulties of the operation are increased but little; they are still easily

torn from their roots, or buried with a little earth. But as the season advances their hold on the soil grows rapidly more firm, and, if hoeing is delayed too long, it will require considerable power to drive the hoe or the cultivator through the soil. Their tenacity of life will be increased, so that to be destroyed the dirt must be shaken from their roots, and they must be left with care on the surface. There will hardly be more weeds than at first, but they will be stronger. Judge French, of Massachusetts, and J. J. Thomas, of New York, most excellent farmers, have each constructed implements designed to take advantage of the weakness of young weeds. That of Judge French is a cultivator with numerous fine, harrow-like teeth. It passes between the rows and close to the plants to be cultivated, and easily stirs up very fine the surface soil while it is yet mellow, thereby playing fine havoc with the small weeds. If the operation is often repeated, and the weeds in the rows or hills are removed in season by the hoe or hand, the real labor of hoeing and weeding—the tearing out of large, strongly rooted weeds—is not experienced. This is taking the timely stitch in hoeing, and making light work of it. Mr. Thomas's invention is a large harrow, abundantly furnished with fine teeth. It is used broadcast over corn, potatoes, etc., soon after the crop comes up. A backward inclination of the teeth enables them to pass by the more finely rooted plants of corn, etc., while the weeds are thoroughly torn up or covered in the soil. Other implements are constructed for the same work. Their efficiency depends upon their ability to pulverize the surface thoroughly. This is the theory of good cultivation: Stir the soil early, and stir it often. It will then be easily and perfectly done; and, if in the earth brought up from the bottom of the furrow, fresh seeds start, they can gain no advantage.

Summer fallowing, as a means of subduing foul land, and of benefiting it in other important respects, is too little practiced in Vermont farming. The first growth of weeds being plowed under before there is any danger of their dropping seed, another crop will spring up from the fresh soil brought up from below. Repeated plowings will exhaust the reserved forces of the weeds, and render the task of subsequent cultivation less onerous; will leave the soil in a light and friable condition; will enrich it by the weeds returned to it, and will greatly promote the weathering process by which the mineral elements of the soil are dissolved and rendered available plant food. Whoever adopts the practice of an occasional summer fallow will not be likely to abandon it. A light harrowing of weedy ground, particularly grain stubble, just as the fall rains begin, will cause the germination of many weeds, which the autumn frosts or fall plowing will destroy. A large number of perennials establish their young plants during the latter part of summer, and they are destroyed much more effectively by fall plowing than they are if not turned over till spring. The scythe may play an important part in the destruction of weeds. It not unfrequently happens that, for some unavoidable cause, there are patches of weeds on the farm that have become full grown; but for neglecting to mow these down before their seeds ripen there can seldom be any excuse. But in clearing up all the waste places of the farm,—the barn-yards, fence-rows, etc.,—as well as in subduing the perennial weeds, which give an unkempt look to the pasture grounds, the scythe is our chief reliance. The proper time for this is some time in August. Speaking precisely, it is at the moment when the full strength of the particular plant is above ground—when the growth is about completed. With perennial herbs this is shortly after their blooming;

with briars and other shrubs it is the end of August. The root of plants performs a two-fold office—that of a collector of food, and of a conservitor of food. At the time of which we are speaking it has nearly accomplished its summer's work of seeking, food in the soil, and is about to receive back from the leaves the stores of assimilated food to hold in safe keeping for ready use upon the return of spring. To sever, at this time, the top and the root is to leave the root feeble and empty. If it survive the winter, it will make but a slender growth the succeeding season, and will now readily succumb to a second mowing.

Habitual care should be exercised respecting the seeds of weeds. They are under our control when the waste places of the farm are cleared up. The rubbish which contains them should be carefully gathered, dried and burned. Such is not fit material for the compost heap or the barn-yard, whence the seeds will surely be scattered wide again. They come into our possession with the screenings of the separator at threshing time. Sending these screenings to the grist-mill, because they contain a little grain, is very mistaken economy. They are full of seeds which the mill-stone will not crush, and which, if fed to stock, will eventually be deposited in well-manured seed-beds of mellow soil. Raise a smoke with all such vile stuff you can get hold of. The seed grain we sow should be examined with care. With the abundance of good seed and of grain separators that are perfect in their operation, there need be no necessity of sowing vexation and loss.

There is a class of plants, and most of them are perennials difficult to eradicate, against whose approach the farmer is helpless to shield himself. Every breath of wind which passes over the tilled field, in their seed time, drops

upon the soil their germs. Such are the thistles, asters, golden-rods, dandelions, milk-weeds, etc.

But, bad as they are, there is a little compensation in weeds. We have seen how they serve as green manure to be plowed under in summer fallows. Their destruction is the imperative necessity which compels us to stir the soil of our hoed crops as often as the welfare of the plants requires. Were this necessity removed, would we always do it? Some very conservative farmers (they are not "book farmers," they would have you know) still believe that weeds are useful in shading the ground. The shade of pumps! Every plant is a pump, sucking moisture from the depths of the soil to supply the place of that which it gives off from its leaves. Did you ever turn over a heavy growth of clover late in the spring? What a succulent mass of fresh verdure above; how dry the earth below. Did you ever see how fresh and green, during a summer drought, will be the outer row of corn, which stands next a plot kept in clean cultivation and without a crop, while the leaves of the inner rows, shaded though the soil be, will be rolled up by the heat? I have seen it.

"And weeds are worth five cents a bushel on my grounds." The correctness of this quotation will appear in this way: I apply twenty bushels of them as a mulch about fruit trees standing in grass, (I have a few such planted in situations where cultivation is impracticable,) spreading it a foot deep for some distance around the tree. The tree may now be worth three dollars. Two years hence it will be worth five dollars, of which one dollar may safely be attributed to the mulch, which keeps the ground cool and moist, rots, and washes down as choice food for the roots. But I don't want to grow weeds at that price.

I will proceed to give a list of the most important weeds of Vermont agriculture, omitting some plants which, though inferior to the cultivated grasses, yet contribute somewhat to our pasturage or our hay crop, many worthless plants which interfere but little with cultivation, because their *habitat* is the woods or the swamps, and a host of others of various character, so sparsely scattered over meadow and pasture, highland and lowland, as to give the farmer little trouble, or hardly to attract his notice. The arrangement of the genera and the nomenclature is that adopted by Gray.

I wish to preface this list with the advice to every young farmer to study Botany if he can. Let him get Gray's "School and Field Book of Botany," and improve some of his spare hours in learning something of the structure of plants, and of the laws of vegetable life and growth, and in making the acquaintance of the plants he daily meets, so that he will then be able to distinguish the useful from the worthless, the indigenous from a dangerous new comer, and the innocent ones from the poisonous. Every plant he meets will then have a secret to tell him, and as a farmer he will not grope in the dark among the mysteries of the vegetable world. He will make few blunders. He will not plant his seeds so deep that they will lie dormant for many days, shut out from the influences of the atmosphere and the heat of the sun. He will not defoliate his plants in order to hasten the maturity of their fruits by exposing them to the rays of the sun. He will not attempt to graft scions of his fruit trees into the maple, nor hybridize the apple with the pear. He will not believe that wheat can turn to chess. With some knowledge of Botany and the other sciences which aid Agriculture, he will shape his methods intelligently, and earn a high degree of success.

## SERIES I.

### PHÆNOGAMOUS OR FLOWERING PLANTS.

## CLASS I.

### EXOGENOUS PLANTS; OUTSIDE GROWERS.

## SUB-CLASS I.

### ANGIOSPERMÆ; WITH CLOSED SEED VESSELS.

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DIVISION I.—*Polypetalous Exogenous Plants.*

1. RANUNCULUS ACRIS, *Buttercups.* Our moist meadows and pastures in June glitter quite decidedly with this weed. Cattle reject it as much as possible, on account of its acrid juice; but, as this is dissipated in drying, the plant does little injury amongst hay. Another species, R. BULBOSA, quite as troublesome where abundant, and still nine other species, are occasionally met with in this State.

2. CAMELINA SATIVA, *False Flax,* is a noxious weed always associated with flax. It remains a weed, when that crop has been grown.

3. CAPSELLA BURSA PASTORIS, *Shepherd's Purse,* is one of the commonest weeds, and one of the first in spring to blossom and ripen its seeds.

4. SINAPIS ARVENSIS, *Field Mustard, Charlock,* often abundant in grain fields, and conspicuous from its yellow blossoms. To eradicate it, it must be pulled while in blossom, as it sheds its seeds before grain is ripe. As its seeds, when buried in the soil, preserve their vitality for many years, it often makes its appearance after a sod has been turned.

S. NIGRA, *Black Mustard,* becomes a weed in rich, waste places about the farm buildings.

5. Hypericum perforatum, *St. John's Wort*, is a pernicious weed of grass lands, with acrid juice and showy yellow flowers. Six other species are found in Vermont, mostly in wet places.

6. Agrostemma Githago, *Cockle*, is the pest of the wheat field, its seeds injuring the appearance of flour, and, when very abundant, rendering it unwholesome.

7. Stellaria media, *Chickweed*, common everywhere, is particularly troublesome in shady places of orchards and gardens, where but a short time suffices for it to form a dense mat over the ground. As its strongest growths are made early in spring or late in summer, after cultivation is no longer advisable; it enjoys great immunity from molestation. Happily, it seldom passes our severe winters.

8. Portulaca oleracea, *Purslane*, a plant proverbially mean. In the earliest stages of its growth it readily dies in the sun, when brought out upon the surface. After it attains size, it must be inverted; or, better, it may be raked up and fed to pigs.

9. Malva rotundifolia, *Common Mallow*. Found in rich, neglected gardens and yards. Its long and tough tap root is not easily drawn from the soil. It makes itself the more troublesome from its ability to pass our winters and make a strong growth in spring.

10. Rhus venenata, *Poison Sumac* of swamps, and R. Toxicodendron, *Poison Ivy*, running over stumps and knolls of low, unimproved meadows, should be known to all. They are poisonous to the touch, and even the effluvium in sunshine affects some persons.

11. Spiræa salicifolia, *Meadow Sweet*, and S. tomentosa, *Steeplebush*, are weedy shrubs of wet lands.

12. Agrimonia Eupatoria, *Agrimony*, a coarse, useless perennial, occurs not unfrequently in the partial shade of fence-rows and wood-sides.

13. Potentilla Canadense, *Cinque-foil*, or *Five Finger*, very common in dry, barren fields. As a forage plant it is a very poor substitute for the grasses, which a better husbandry would invite to supplant it. Two kindred species are often found with it, and three others are met with in bog meadows.

14. Rubus odoratus, *Purple-flowering Raspberry*, R. Strigosus, *Red Raspberry*, R. occidentalis, *Black Raspberry*, R. villosus, *Blackberry*, and R. Canadensis, *Dewberry*, deserve to be mentioned among the weeds of agriculture. Taking possession of fence-rows and out-of-the-way places, or straggling over unimproved pastures, they disfigure the farm.

15. Rosa Carolina, *Swamp Rose*, R. lucida, *Dwarf Wild Rose*, R. blanda, *Early Wild Rose*, and R. rubiginosa, *Sweet Briar*, are other troublesome shrubs. The two first, in low lands, form thickets not easy to subdue. The seeds of the last, scattered by birds, produce offensive briars in dry lands.

16. Epilobium argustifolium, *Willow herb*, is a tall plant, common in newly cleared land. Its rose-colored flowers are very showy.

17. Œnothera biennis, *Evening Primrose*, sometimes cultivated on account of its pretty yellow flowers, becomes in the field a coarse, woody weed.

18. Sedum Telephium, *Live-for-ever*, has in many places escaped from gardens, and become a great evil in pastures and meadows. Its well-known tenacity of life makes it ex-

ceedingly difficult to eradicate. Where it exists only in small clumps, scattered over the field, undoubtedly the best course is to dig it out clean, and burn it in alternate layers with brush and old wood. Where it has obtained the entire possession of the soil, nothing but trench-plowing, burying it deep, will redeem the land. It will thrive on a bare rock, and I have seen it flourishing in a shady swamp, where a neighbor had deposited it.

19. DAUCUS CAROTA, *Carrot.* No family of plants needs more close attention from the farmer than the UMBELLIFERÆ or *Parsley* family. The cultivated species of this order, the *Carrot*, the *Parsnip*, PASTINACA SATIVA, *Caraway*, CARUM CARUI, etc., are very liable to escape from his hands and become very troublesome in the fields. Only a few years suffice to revert them to their wild forms. The *Wild Carrot* is established as a weed in many places in our State. Darlington tells us: "When it gets on the premises of a careless, slovenly farmer, it soon multiplies so as to become a cause of annoyance to the whole neighborhood." He recommends that it be diligently eradicated, before it matures seed. The parsnip is, with us, more common in a wild state than the carrot, but it prefers to keep closer to rich fence-rows and the sites of old houses. Hardly less ability to maintain an independent existence is shown by caraway. These plants, when seed is grown from them, should be planted in open tilled soil, in order that the self-sown plants may be destroyed under the implements of tillage.

Besides these the order contains several poisonous plants, of which the following are observed in Vermont:—CICUTA MACULATA, and C. BULBIFERA, *Cow Bane*, destructive to cattle when eaten by them, and common in swampy meadows and pastures; SIUM LINEARE, *Water Parsnip*, swamps

and brooks; and CONIUM MACULATUM, *Poison Hemlock*, frequent in waste places. The importance of sufficient botanical knowledge to identify these, and distinguish them from others of the same species which are quite harmless or even useful, but which closely resemble them, as OSMORRHIZA LONGISTYLIS, and O. BREVISTYLIS, the two forms of *Sweet Cicely*, which are very common in our moist woods, and the roots of which are sought for their aromatic properties, must be apparent. It is not rarely that *Cowbane* is mistaken for this latter plant, and sometimes with fatal results.

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DIVISION II.—*Monopetalous Exogenous Plants.*

20. SAMBUCUS CANADENSIS, *Common Elder*, loves to establish itself along old stone walls, under whose foundations and throughout all the adjacent soil, it weaves its rope-like roots, which are tenacious of life, and can bud throughout their whole length. S. PUBENS, *Red Berried Elder*, in dry, rocky soil, does not spread by running roots.

21. DIPSACUS SYLVESTRIS, *Wild Peasel*, is naturalized in some parts of the State, and may become a nuisance if not attended to.

22. EUPATORIUM PURPUREUM, *Trumpet Weed*, and E. PERFOLIATUM, *Thorough Wort*, are homely weeds, common in low grounds.

23. ASTER. We have nineteen species of this genus. Thinly scattered, for the most part over open woodlands, cool, mountain pastures, or low grounds, they give the farmer little trouble.

24. ERIGERON. Five species of this genus cause us much annoyance. E. ANNUUM, and E. STRIGOSUM, *Daisy Fleabanes*, acrid plants, mingle their coarse stalks quite too freely with the hay from newly seeded land. In the hay

they emit a pungent odor, which causes sneezing and coughing.

25. SOLIDAGO NEMORALIS, and fifteen other species of *Golden Rod*, may be found scattered over every variety of soil. Coarse perennial herbs, with wand-like stems and yellow flowers. Should be devoted to the scythe.

26. INULA HELENIUM, *Elecampane*, is a coarse, offensive plant, that sometimes gives a slovenly appearance to the road-side. It also invades moist pastures, and straggles along cool brooks.

27. AMBROSIA ARTEMISIÆFOLIA, *Bitter Weed*, *Ragweed*, a detestable weed, everywhere about barn-yards, and particularly infesting wheat stubble. A. TRIFIDA, a ranker species, occurs in rich soil of river banks.

28. BIDENS FRONDOSA, *Beggar-ticks*, common in rich waste places and cultivated fields; becomes exceedingly annoying in autumn from its seeds adhering to clothing, etc., by means of their two barbed awns. Four other species are troublesome in wet lands.

29. MARUTA COTULA, *May-weed*, an acrid herb, with a nauseating odor. In the vicinity of farm buildings.

30. ACHILLEA MILLEFOLIUM, *Yarrow*, cattle may eat, as it mingles its bitter foliage with grass; but it is doubtful whether it is a wholesome addition to their food.

31. LEUCANTHEMUM VULGARE, *Ox-eye Daisy*. Go to Darlington, and he will tell you that this is a "vile intruder," and a "great nuisance," and, if your farms are clear of it, you will do well to share his opinion. But over the fields of the Champlain Valley it spreads in June its white banners, and at risk of being told that I belong to a community of "slovenly farmers," I confess myself at loss to know

whether to call it a weed or a valuable forage plant. Under the frequent droughts of the past dozen years, it has increased rapidly over our valleys, and to oppose any check to its progress has been quite beyond the power of man. It has supplanted timothy to a considerable extent. Some farmers have thought that it runs out that grass; but it seems more reasonable that the failure of timothy is due more to severe droughts and frosts, and to the partially exhausted condition of our old lands. The daisy more properly *succeeds* timothy, where the latter has failed. Deep tillage and liberal manuring of these lands will enable timothy to hold its own against the daisy for many years. A limited experiment with phosphate suggests to me very forcibly that these lands are deficient in that mineral, and that timothy requires its presence in considerable amount. We do know that much of our first cleared upland was injured by too continuous cropping with wheat. That crop must have taken a large amount of phosphoric acid from the soil. As a weed in cultivated land, the daisy gives us but little trouble. In pastures cattle do not seem to relish it; but in the meadows, if cut when in blossom and properly cured, it makes sweet and nutritious hay, which cows and most horses eat with avidity. Enduring the drought better than the grasses, and thriving even on dry clay, it has really proved a reliance in seasons when our hay crop has been the lightest.

32. TANACETUM VULGARE, *Tansy*, has escaped from gardens in many places, and forms dense patches which are constantly enlarging.

33. ARTEMISIA VULGARIS, *Mugwort*, is a species of Wormwood, in waste places near dwellings.

34. ANTENNARIA MARGARITACEA, *Pearly Everlasting*, a perennial, occupies the knolls of cool, hill pastures. A

PLANTAGINIFOLIA, commonly called *Mouse-ear*, is a low everlasting. As on our dry and worn-out clay soils the daisy succeeds the grasses after they can no longer find sustenance there, so this humble and perfectly worthless plant follows the daisy, after that gives up the field. It is the last vegetation with which these lands can robe themselves, and the ghastly hue of the plant is appropriately suggestive of the condition of the soil beneath it.

35. ERECHTHITES HIÆRACIFOLIA, *Fireweed*, is very certain to show its tall form in recent clearings that have been burned over.

36. CIRCIUM LANCEOLATUM, *Bull Thistle*, is a biennial of pastures and road sides everywhere. Besides this, and the following, four other species of rare occurrence are indigenous here. Chief over all weeds in the odium of the farmer has long been placed C. ARVENSE, the Canada Thistle. Spreading its downy pappus to the wind, it laughs at the pains of the farmer to keep clear of it. From neglected fence rows or road sides, from fields of grain ready for the reaper, from hillside pastures, from far and from near, its seeds start up on their balloon flights to seek fresh fields for colonizing enterprise. As surely as we take up a piece of land for the plow, so surely will thistles spring up over it. And, with average cultivation, they will not disappear till the land has been seeded to grass and mowed two or three years. The strength of this thistle is in its creeping root-stalk, which lies at some depth in the soil. Turning and breaking up that with the plow is of no avail. Such is only the culture and propagation which the plant invites. Every inch of this root-stalk is capable of producing a new plant. Our only course is to smother it till it rots—that is, to remove the stalk as often as it appears above ground, thus de-

priving it of air and weakening it till, at last, it succumbs and dies. To do this work requires a cultivator that will cut off every stalk each time it passes.

37. ONOPORDON ACANTHIUM, *Cotton Thistle*, is naturalized in a few places.

38. LAPPA MAJOR, *Burdock*. Even the most negligent farmer will abate this dreadful nuisance.

39. CICHORIUM INTYBUS, *Wild Chicory*, a plant related to the next. It has a branching stalk, about two feet high, and large, showy, blue flowers. Its recent and rapid advance upon us should excite alarm. It is believed to impart a bad taste to the milk of cows feeding upon it. Its root must be drawn out of the soil.

40. TARAXACUM DENS-LEONIS, *Dandelion*, very abundant in pastures, cattle do not reject. In garden culture it is a bad weed to remove. Unless its spindle shaped roots are drawn out bodily, they emit buds from the upper end of the portion left in the soil, and the plant is renewed.

41. SONCHUS OLERACEUS, and S. ASPER, *Sow-Thistles*, herbs with milky juices and soft spines, appear in manured soil and peaty grass lands.

42. LOBELIA INFLATA, *Lobelia*, a poisonous herb, freely scattered over dry, open fields. L. CARDINALIS, *Cardinal Flower*, a beautiful, scarlet flower, growing by brook sides, is easily introduced into the flower garden.

43. PLANTAGO MAJOR, *Plantain*, common near dwellings, and a plant of which cattle are fond, is out of place in mowed land, because so low that it is not readily gathered in the hay. P. LANCEOLATA, *English Plantain*, with narrow leaves, occasionally makes its appearance in dry fields.

44. VERBASCUM THAPSUS, *Mullein*, is very surely to be found in dry, rocky pastures. Its abundance there gives evidence how common is the neglect of such land. Pulling the stalks while in blossom, for a few consecutive years, is suggested as an easy means of clearing fields of this rank and useless weed. V. BLATTARIA, *Moth Mullein*, is less common.

45. LINARIA CANADENSIS, *Wild Toad Flax*, is indigenous in sandy soil; and L. VULGARIS, *Butter and Eggs*, a showy plant, has escaped from gardens, and become a pernicious weed, forming dense patches difficult to eradicate.

46. VERBENA HASTATA, *Blue Vervain*, and V. URTICIFOLIA, *White Vervain*, worthless weeds, disfigure old fields and road sides.

47. MENTHA VIRIDIS, *Spearmint*, M. PIPERITA, *Peppermint*, and N. CANADENSIS, sometimes called *Horsemint*, our various mints, pleasantly fragrant about springs and cold brooks, sometimes appropriate to themselves more space than is profitable.

48. NEPETA CATARIA, *Catnip*, when permitted to occupy the rich soil of the neglected nooks about dwellings, becomes an unsightly weed. N. GLECHOMA, *Ground Ivy*, or *Gill*, a running vine in shady places near dwellings, is less conspicuous.

49. GALEOPSIS TETRAHIT, *Hemp Nettle*, an annual, with spreading branches; is a very vile weed, frequent in waste places and manured ground. Another species, G. LADANUM, is less common and less offensive.

50. LEONURUS CARDIACA, *Motherwort*, is usually associated with *Catnip*, and is rather more troublesome than that.

51. Lithospermum officinale, *Gromwell*, is a disagreeable perennial that is scattered too freely over butternut hills. From a tough, spindle-shaped root arise several stalks, bearing smooth, ivory-like seeds. L. arvense, *Corn Gromwell*, with rough, gray seeds, occurs on sandy banks and by road sides.

52. Echinospermum Lappula, *Stickseed*. The acquaintance of this plant, as well as of the two species of the next genus, the farmer is likely to make quite unpleasantly. Their seeds are armed with hooked or barbed prickles, and adhere in great numbers to the coats of animals.

53. Cynoglossum officinale, *Hound's Tongue*, and C. Morisoni, *Beggar's Lice*, are common in open woods. Vile weeds.

54. Solanum nigrum, *Night-Shade*, occurs sparingly in shaded grounds and pastures. The flower resembles that of the potato, and the fruit is black and of the size of a pea. Even children should know it, because its berries are reputed to be poisonous.

55. Physalis viscosa, *Ground Cherry*, has its natural habitat in light, sandy soil, in some parts of the State. Some fifteen years ago this plant, together with a species from Europe, P. alkekengi, was widely introduced to cultivation. Trying it at the time, I found that in our seasons it ripened but a small part of its fruit before frost, and I decided to reject it. But every year since its weedy form has appeared in my garden from seed dropped years ago.

56. Hyoscyamus niger, *Black Henbane*, powerfully narcotic and poisonous; has in our State occasionally escaped from gardens.

57. Datura Stramonium, *Jamestown-Weed*. This rank,

poisonous weed is found in rich waste places, particularly about our towns.

58. ASCLEPIAS CORNUTI, *Milkweed*, occasionally appears in good soil. It resembles the Canada thistle in two respects,—in its mode of disseminating its seeds, and in its creeping root-stalks, which render it difficult to eradicate when well established.

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### DIVISION III.—*Apetalous Exogenous Plants.*

59. CHENOPODIUM HYBRIDUM, *Goosefoot*, a heavy scented weed, and one less common than C. ALBUM, *Pigweed*, which is one of the most abundant weeds in cultivation. They ripen their seeds while yet appearing quite green.

60. AMARANTHUS RETROFLEXUS, *Red Root*, is even more common than the Pigweed. A. HYBRIDUS and A. ALBUS are two other common species. All are stout and hateful.

61. POLYGONUM PERSICARIA, *Lady's Thumb*, is another most common weed. With stems greatly branching and rooting when they meet the soil, it is not easy to clear up after it gets large. P. HYDROPIPER is *Smartweed;* abundant under the eaves of barns and in peaty hollows of wet pastures. P. AVICULARE is the *Knotgrass* of dooryards, but is not restricted to that place, P. CONVOLVULUS is *Black Bindweed*, a great annoyance everywhere.

62. RUMEX OBTUSIFOLIUS, *Bitter Dock*, R. CRISPUS, *Yellow Dock*, our commonest form, and R. SANGUINEUS, *Bloody-veined Dock*, require to be pulled and dried on a rock. R. ACETOSELLA, *Field Sorrel*, is an index of worn or sterile soil. It disappears under the good husbandry which encourages the growth of better plants.

63. Euphorbia humistrata, E. maculata, and E. hypericifolia, are the most common of our five species of *Spurge Herbs*, with milky, acrid juice.

64. Urtica dioica, *Great Stinging Nettle*. A quaint old herbalist remarks that this terrible weed "may be found by feeling in the darkest night." Surely one need not feel far along the sides of old walls to find it. Mowing its stalks is not enough; its subterraneous stems, creeping near the surface of the ground, should be dug out and thoroughly dried or burned.

65. Corylus Americana, and C. rostrata, (the species most common with us,) *Hazel-nuts*, form wide thickets in neglected fields. Such demand the attention of the thorough farmer.

66. Salix, *Willow*. Several species of low, useless willow infest wet land.

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## CLASS II.

### ENDOGENOUS PLANTS; Inside Growers.

67. Symplocarpus fœtidus, *Skunk Cabbage*. A perennial herb, with a strong odor like that of a skunk. Its bunches of large leaves are an offense in wet meadows.

68. Acorus Calamus, *Sweet Flag*, sometimes takes possession of wide patches of wet meadows.

69. Iris versicolor, *Blue Flag*, is common in wet places. A fine flower; but it trespasses upon the pasturage.

70. Allium tricoccum, *Wild Leek*, is abundant in rich, cool woods of the western side of the State. Cows often eat it, when it imparts a disgusting flavor to their milk.

71. VERATRUM VIRIDE, *White Hellebore*, or *Indian Poke*. A coarse, poisonous plant of swamps and low grounds.

72. JUNCUS, *Rush*. Of this genus we have seven species. They are the mark of cold, wet soil; and when abundant suggest the necessity of drainage.

73. CAREX, *Sedge*. Fifty-seven species of this large genus have been noted in Vermont. They are all of inferior value in agriculture; and many of them are worthless, or worse than that. They form most of the herbage of low grounds. Perennial herbs, chiefly flowering in April or May, and distinguished from the true grasses by their triangular stalks; also their leaves are usually rough on the margins. Under the popular name of "*Wild Grass*," they are much cut for hay; but this is much less nutritious than that composed of the grasses. So, the efforts of the farmer to improve his low meadow, and substitute for these sedges timothy or red-top, are wisely made. One species deserves special mention from its manner of growing in dense tufts two feet or more in height. Its roots rise in a compact bundle nearly a foot from the surface, and, as these tufts are sometimes strewn quite freely over low meadows, they present vexatious obstacles to the course of the mowing machine. They should be cut off even with the surface of the sward, and carried off the field. The species is C. STRICTA.

74. BROMUS SECALINUS, *Chess*, and another of very similar species, B. RACEMOSUS, are unnecessarily common in grain-fields. No careful farmer will sow chess with his seed wheat; then he will keep clear of it, for wheat does not turn to *chess* any more than to cockle. Two wild species also occur in dry woodlands and open places.

75. TRITICUM REPENS. Its various English names, *Couch*, *Quack*, *Quitch*, *Quick*, *Bunch*, *Joint*, *Snake*, *Witch* and

*Devil Grass*, attest how wide-spread it is becoming, and also in what bad esteem it is held among farmers. It is by far the most troublesome and obstinate pest which I encounter in farming. Respecting this grass I would like to raise among Vermont farmers a loud note of alarm; for, while it is fast gaining ground amongst us, I find that scarce half the farmers of my acquaintance know the plant, or are apprised of how much danger lurks under its fine stalk. Botanically, it is next of kin to wheat, being a species of the same genera with that. Introduced from Europe in an early day, it has planted itself in all the older settled portions of the Northern States. It is an aristocratic plant, and loves high living and the best of society: so it chooses out the very choicest land of our old homesteads,—the gardens and the vicinity of barns,—and so it moves into town; and, alone of all the grasses, crowds upon the curb-stone of the city street. It is perennial,—may I not say *eternal?* for once in a field it never lets go its hold on the soil.

It is the creeping root-stalk of *Couch Grass* which gives the farmer trouble. Tough and wiry, they weave themselves through the soil in a thick mat, that greatly impedes cultivation. When, at cost of much team power, the tough sod is turned, the bristling spears of grass push from the back of the furrow, and grow with the same vigor as before. If grain be sowed on such land, but a poor result is likely to be realized, and any attempt at raising hoed crops will require much toil.

He who sets out to subdue a piece of *quack* must resolve on no half-way measures. It is of this pest that Mr. Warner, in "*My Summer in a Garden*," says that "extermination rather helps it." Surely it thrives under the cultivation which clears land of ordinary weeds. Under ordinary care,

a mellow tilth is prepared for it, and its broken root stalks, every piece of which will produce a new plant, are caught in the harrow or plow, and strewed evenly over the whole field. Thorough treatment includes summer fallowing, (and the summer needs be a dry one,) with repeated plowing, harrowing, cultivating, and raking off of the roots each time brought to the surface. These must be dried and burned. This course, well followed out, will in a dry season clean the land; though roots enough for another start will always remain. Trench-plowing, which buries the surface soil containing the roots deep beneath a furrow of subsoil, I have found to be an efficient method of subduing the pest.

There are many farms in Vermont where couch grass is only partially established, or perhaps exists in obscurity. It may be only a strip of respectable-looking grass along the garden-fence, a patch near the barns, a sod about the apple-trees, or a narrow border in the head-lands of the field. If there is no more than this, the owner will do well to fork over the whole and rake out the roots. It can be kept under control in this way. Three years ago I found couch in one end of my young pear orchard. It was scattered over nearly an acre, the roots in some places being completely interwoven with the soil. A hired man and myself, with a spading fork and a potato-hook, dug out in three days about twenty bushels of the roots. The next spring we got but one or two bushels; and last spring I found but a half bushel.

Cut very early, before the stalk becomes tough, couch grass makes very good hay. It is lighter and less rich in sugar, starch and gum than timothy, I think, yet cattle like it. There is an old adage to the effect that, if you give the devil rope enough, he will hang himself. It is not so with

devil grass. Give it the possession of the soil ten years, and you may think it has run itself out. But plow and manure again, and see it mount up again in full hatefulness.

76. PANICUM SANGUINALE, *Crab-grass*, a spreading annual grass, is a common weed of cultivated soil, and is very abundant in autumn in dry, sandy grass-lands. P. CAPILLARE is common in similar situations. In autumn the dry stalks break off; and the light, finely-branching seed heads, rolled over the field in the wind, collect in abundance against fences, etc. P. CRUS-GALLI, *Barn-yard Grass*, also an annual grass, with the two species of SETARIA mentioned below, and, with *Pig-weed* and *Red-root*, form the bulk of our weeds of cultivation. This is, in the quasi cultivation it has received, an extremely variable species. Its dense panicled heads vary from awnless to coarsely awned, and in color from green to purple. Flint says: "Some experiments have been made to cultivate this common species in the place of millet, to cut for green fodder. It is relishod by stock, and is very succulent and nutritious." As a weed it has a very rank, rough appearance. It runs into grass lands, along the sluices from the barn-yard.

77. SETARIA GLAUCA, *Foxtail*, is common everywhere, particularly in stubble. In autumn it gives to dry grass lands a tawny appearance. Its herbage is of inferior quality. S. VIRIDIS, *Green Foxtail*, is of larger growth, and bears a close resemblance to *Millet*, with which it will hybridize.

Of the 129 species named above, 70 are believed by botanists to have been introduced from the old world. These include nearly all our most aggressive and prolific weeds. Such are the *Thistles*, *Nettles*, *May-weed*, the *Daisy*, the *Docks*, *Chicory*, the *Mulleins*, *Pig-weed*, and the *Foxtails*,

—sorts which probably comprise nine tenths of th stalks, mass of noxious vegetation. And yet, to these we ar ught ing constant additions. Imported from every part of ole world, along with new plants and seeds, they are unwittingly planted in our soil, and set going in their endless course.

It is with weeds as with all difficulties of human experience,—the easiest way to get along with them is to face them with courage, and struggle against them energetically and hopefully. If we cannot expect to exterminate them entirely, we may keep them under subjection, and good husbandry demands of us nothing short of this.

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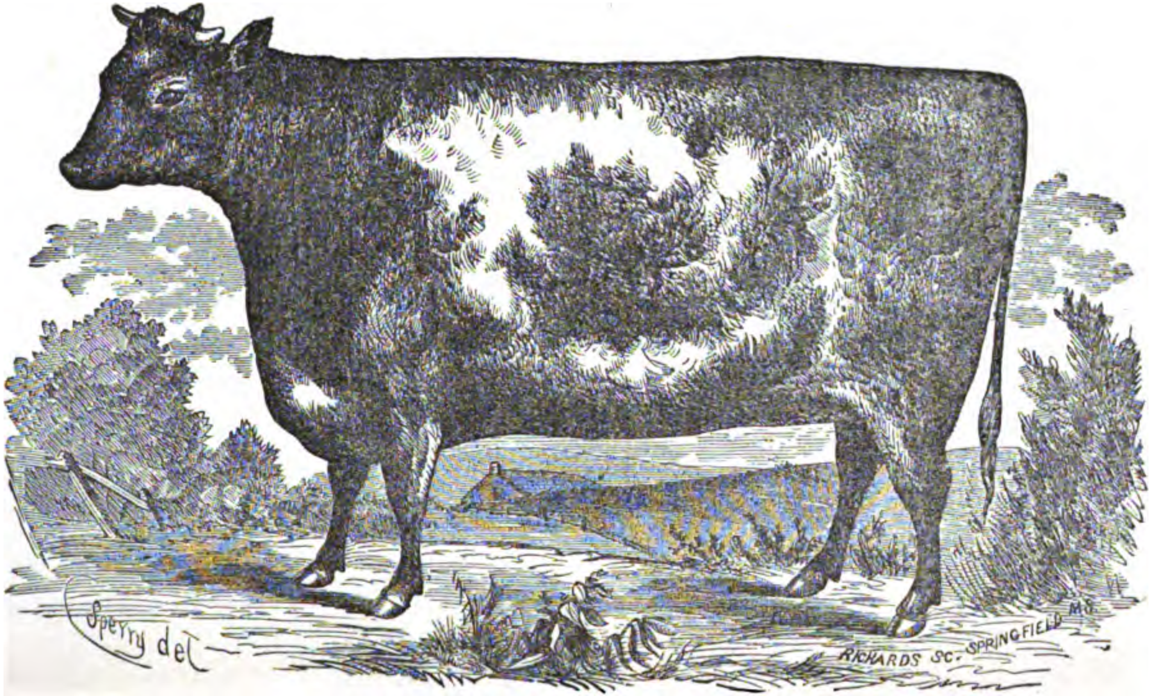


**SHORT HORN HEIFER, BIANCA 5th, at 12 Months.**

***Property of C. Horace Hubbard, Springfield, Vt.***

# VERMONT CATTLE.

A PAPER PREPARED FOR THE MEETING OF THE VERMONT BOARD OF AGRICULTURE, &C., AT NEWPORT, AUGUST, 1872.

BY C. HORACE HUBBARD, OF SPRINGFIELD, VT.,
**Agricultural Editor of the Vermont Record and Farmer.**

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It would be impossible, without trespassing upon the time assigned to others, to treat the subject to which our attention is directed in an exhaustive manner. I shall attempt nothing of the kind. It is my purpose, rather, to suggest for your consideration some thoughts which have occurred to me, from time to time, in the daily care of my own stock, and the impressions derived from my observation of the cattle of other farmers and breeders, and their treatment. The conclusions at which I have arrived have often been forced upon me by the varying success and not infrequent mistakes in the care of my own stock. If I am so fortunate as to open the subject for a discussion that shall draw out the results of your experience, many of whom have enjoyed a wider field of observation, and have made cattle raising the study of a life-time much longer than my own, my purpose will have been satisfied.

## IMPORTANCE OF THE SUBJECT.

The farmers of Vermont have been and are behind the age in the improvement of cattle. There has been, within the past fifteen years, a partial awakening on the subject,

and some laudable effort at improvement, but the movement has been far from general. He who presumes to address the public on this question has no right to gloss over the truth. It is undeniable that we are behind the age. Every farmer who has kept two or three cows and a few young cattle, for a half a dozen years, knows very well that there is a vast difference in the rapidity of growth and in the product of beef, milk and butter or cheese, in proportion to the food consumed, by different animals. There is a difference in digestive capacity, the power to assimilate the nutriment contained in the food consumed, and convert it into the various tissues of which the body is composed and into milk. Where the digestive capacity is insufficient, a portion of the nutriment passes off in the excrement and is, in one sense, lost. If there is a want of harmony or balance in the development of the various functions and the action of the several organs, the result of breeding, training and habit, or other causes, or if the temperament is nervous and excitable, the consequence is that the nutritive properties of the food are expended in the undue and unprofitable development of certain parts or functions at the expense of others,—such, for instance, as a too rapid growth of bone, causing coarseness, or a tendency to lay on flesh at the expense of the quantity or quality of milk,—or there may be a great waste of nervous force in unnecessary activity and restlessness, which must be restored and sustained by the food consumed. It should be the object of the breeder and the farmer to produce animals which will give the greatest possible return for the food consumed. To accomplish this, the animal must be so constituted as to consume a large quantity of food, so that, after so much is withdrawn as may be necessary for maintaining the heat of the body and nourishing the various organs, supplying the constant waste, there will be a large

balance left to be converted to some use which shall afford a direct profit to the farmer, such as milk, flesh and fat, or reproduction. The quality and value of these several products varies greatly in different animals, and may and should be controlled by the breeder.

It is impossible to make any accurate estimate of the increased value of the cattle of the State, if all were improved by breeding as much as they easily may be. There can be no doubt, however, that many millions of dollars may, in a few years, be added to the annual revenue of the farmers of Vermont by systematic and persevering efforts in the improvement of the common stock of the country.

## SYSTEMATIC IMPROVEMENT.

There are certain laws regulating the transmission of qualities from one generation to another which are unchangeable. While the farmer cannot, like the manager of a herd of thoroughbred stock, give his whole thought and study to these laws and their application, he must admit their existence, and, so far as his circumstances will allow, seek to understand their principles, and apply them in the management of his own stock. It is a grave mistake, however, to suppose that the selection of proper animals for producing the right kind of cattle for the farmer to have is more than a small part of what is necessary in raising and keeping good stock. Judicious breeding lays the basis of a good herd of cattle, but it avails nothing without subsequent wise care and management. The best and choicest animals may become stunted by exposure and starvation, or be spoiled by irregular feeding, or have their dispositions ruined and usefulness destroyed by harsh and cruel treatment. A uniform system of good breeding and prudent management alone can give good cattle to the State. Neither of these essentials is

beyond the means or above the ability of any common farmer.

## BREEDING.

### SELECTING PARENTS.

It is not my intention to enter upon an elaborate discussion of the principles of breeding. There are a few well-known and generally admitted rules applicable to the subject, which the farmer cannot disregard. The law of similarity, or that "like produces like," is too well established to admit of a doubt. It is also pretty well known that ancestral influences usually extend through several generations, varying in duration in proportion to the generative force of the animal from which they are derived, and the counteracting influence on the other side. And this brings us to the chief difficulty which farmers always have to meet: It is the tendency *to deteriorate*. This difficulty will probably always exist. The higher the order of improvement which has been attained the more active is this tendency. It springs from a natural law which governs all animal and vegetable life, that the animal or the plant having a coarse fiber and structure is more hardy and robust than that which is improved and refined for the use of man, and the latter will give way and become extinct before the pressure of its more rugged neighbor.

Another difficulty the farmer has to encounter is the *want of any fixed type* among the common cattle of the State. The homogeneous origin of the common stock is evident from the great dissimilarity in appearance and want of uniformity in families. The farmer, for instance, having a cow in his herd better than any of the rest for the dairy, keeps all her stock in preference to others, and finds that none of the heifers, of which he expected so much, are equal to their

dam, while some of them may be inferior to the average of his herd. As the blood of many ancestors centers in each animal, so the influence of them all is exerted to some extent in deciding its own character, and the nature of the young it shall bear. These ancestral influences are so conflicting in the common stock that it is impossible to predict which will control, and so the farmer breeds at random.

You will infer, then, from what I have said, that it is of vital importance for the farmer, in selecting the animals to be used in perpetuating and improving his herd, to choose not only those which possess in themselves the qualities he wishes to have transmitted to his young stock, but also those coming from families which exhibit a uniform development of the same qualities in all their members. It is now generally thought by dairymen that the sire influences the character of the young as milkers even more than the dam, and that the sire should be the son of a good milker and from a family of good milkers, in order to be sure of good dairy stock.

The momentous question presents itself to every farmer whether the stock he has is such as he ought to use for breeding, and if not, what is needed and where shall it be obtained? A certain class of breeders of thoroughbred stock are in the habit of advising all farmers to adopt thoroughbreds as the common stock. We have but one answer for them—it costs too much. Not many farmers can afford the expense. For those who have capital to spare for the investment it is very commendable, but he who runs in debt for fine stock, at fancy prices, hoping to make ready sales of increase to meet his payments, may be disappointed. Please remember it is a breeder of fine stock who gives you this advice. While I commend good thoroughbred stock as

worthy of all that can be said in its favor, I would advise every one to act with prudence and economy. There is a more satisfactory and economical method of improving the cattle of the State. It is by the

### USE OF CHOICE MALES.

Let every farmer, having good common cows, enter upon a systematic course of improvement, choosing, year after year, the best males he can procure, preferring those not nearly related to or descended from his herd.

The question here presents itself, shall the farmer use thoroughbred or grade males? This is a question that has two sides to it. Although I am a breeder of Short Horns, I have no bigotry on this subject. The advantage of using thoroughbred males is that their peculiar characteristics are so intensified by a long course of breeding that they are transmitted with far greater certainty and uniformity. The effect of a cross of a good thoroughbred male on common stock is marvelous. I could cite instances that would seem incredible. There are some sanguine persons whose enthusiam on the subject carries them to extremes. They say, "Better use a poor thoroughbred bull than a good grade." While I would not encourage the use of grades as sires, I would advise care in the choice of thoroughbred bulls. If those cannot be found possessing the qualities we would have imparted to our stock, it may in some instances be better to use good grades. Thoroughbred males that appear to possess the qualities needed for the improvement of common stock are sometimes found to be affected with grave faults, resulting from the systems adopted by their breeders, which render them unfit for use. These are delicacy and feebleness of constitution, the result of close breeding and pampering; and poor milking quality, caused by neglect to

develop the same in breeding and by habit. I do not say that these are common faults with thoroughbreds. I am happy to believe that they are not. That they do exist in individuals and in herds there is no doubt. I have seen the disastrous effects of crossing such males on common stock, and can speak from experience if necessary.

In choosing males the farmer must not be misled by a false standard of excellence which gives to fancy points of doubtful importance the preference over utility and practical value. Perhaps the first and most important point is constitution. The stock of the farmer who expects to derive the whole or a part of his income from sales of milk, butter, cheese and beef, must possess robust health and vigor, with power to endure the drain upon the system necessary in reproducing the species and in giving milk, and to bear the ordinary vicissitudes and exposures of our rugged climate without breaking down. They must have great digestive capacity, or they will be unable to transform the bulky forage and crops of the farm into a more compact form of merchandise at a profit to the farmer.

It would seem unnecessary to urge the importance of developing the capacity for milk were it not true that a majority of the cows in the State give no more than milk enough to pay for their keeping. This is a matter which will not take care of itself. The farmer must exercise constant care to improve his cows as milkers. There are so many accidents and diseases to which cows are subject, which destroy their usefulness as milkers, and it is so necessary to realize as much as possible for cows when they are turned, that it seems to me to be of prime importance to cultivate size, early maturity and a disposition to lay on fat. Neither of these is, I believe, inconsistent with the character of a first class milker. Docility of disposition is one of the most

valuable qualities in cattle. The animal possessing a quiet temper fills itself and lays down to ruminate, and the process of digestion and assimilation are carried on under the most favorable conditions. The business of manufacturing bone, muscle, fat and milk from the food in the stomach, goes on quietly and economically. If the creature has a nervous, excitable disposition, it is roaming about the pasture and working off in unnecessary exercise and excitement the nutritive matter which should be put to better use.

Wherever the farmer shall find bulls from such families as this there is his place to buy, whatever be the breed. Individuals have their own preferences and opinions in regard to which is the best breed; and I have no desire to change them. My own opinion is, that for the State of Vermont there is no race of cattle equal to the grade Durhams, the result of crossing Short Horn bulls, of medium size, good constitution, and from families bred and used for dairy purposes, on the common cows of the country. The issue of the first cross is strongly marked with the Durham character, and after a few crosses the herd assumes a uniformity of appearance and excellence which will satisfy the most ambitious farmer. The colors, of course, like the Short Horns, will vary from red to white. The size will be large, cows making from seven to nine hundred pounds, dressed weight, of beef, and the oxen ranging from twelve hundred to two thousand pounds of beef, at five years old. They mature so early, and take on flesh so readily, that there is no difficulty in turning off the steers at three years old in condition to bring the highest price of beef in market. They are hardy, good feeders, good oxen, good cows for butter or cheese. They thrive on common keeping in winter and fair pasture in summer, their wonderful digestive capacity giving them the power to thrive where any cattle

will. I am not advertising my stock. I have no bulls to sell.

THE COW DURING GESTATION AND AT CALVING.

The treatment of the cow during the period of gestation has a marked influence on the character and constitution of the calf. A farmer of my acquaintance, who often milks his cows up to the time of calving, (and thinks it a pretty good way,) says that it takes the steers raised by that system seven years to reach maturity—a year at least and perhaps two years longer than if the cows were allowed to go dry two months. For the sake of her immediate and future descendants, as well as her own, the cow should have a period of rest of at least two months. The cow should also be generously fed always, and treated with kindness. If she is habitually irritated and excited, her calf is likely to be nervous and vicious. As the time for calving approaches, the udder requires attention. If very fully distended the milk should be drawn, and in some cases it is necessary to manipulate and bathe the parts with warm water, always wiping dry and rubbing afterwards to prevent a chill. To prevent inflammation of the udder after calving, the same treatment, with very frequent milking, is very effective. Cold drink should be avoided and exposure to take cold. For milk fever bleeding is the best remedy, and is usually effective if seasonable. Not a moment should be lost, however, as the progress of the disease is very rapid. Every farmer should have a fleam and know how to use it. In case of garget, a liberal dose of physic, with relaxing food, if given soon enough, is a pretty certain cure. It is my custom to give fr m one to two pounds of glauber salts, and repeat the dose in twelve hours if it does not move the bowels freely.

Liberal feeding at this time is not injurious; it is neces-

sary. The great draft upon the system requires it. The food should not be reduced, but light, cooling food, such as a mixture of oat meal and bran, and roots, should be substituted for heating food, like corn meal.

### RAISING CALVES.

If the calf is separated from its mother, the moment it is born, without her seeing it, the trouble of weaning the two is all avoided. It is, on the whole, the best way. Teach it to drink at once. After many experiments, I have come to the conclusion that there is no food for the calf which will take the place of milk. Gruel of oat meal and linseed meal or hay tea are sometimes substituted, and calves can be raised very well on such messes. Milk is the natural food. It contains all the elements necessary to growth. New milk for a while—four weeks if possible—and after that it may be skimmed. The calf should be taught to eat a provender composed of oat meal, corn meal and bran, fed dry, also boiled potatoes, roots, or sweet apples, and when milk must be given up, substitute clear water. A little fine sweet hay will be eaten with relish at an early age if placed in reach. A clean bed and pure air are necessary for the health and rapid growth of the calf. Some authorities claim that the calf and young heifer should always be kept in moderate condition, if not actually lean, or otherwise the tendency to take on flesh will be developed at the expense of the lacteal function. I do not accept the theory. A generous diet, if not of heating food, all the life of the animal, will, in my opinion, do no harm, but be of great benefit and produce a better race of cattle.

### BEST AGE FOR HEIFERS TO COME IN.

It is usual among farmers to have grade heifers come in at two years old. The breeders of thoroughbreds com-

monly give them another year. The question naturally arises, at what age is it best for the future good of the cow for her to bear her first calf, and can the farmer afford to allow the heifer three years of life before she begins to make any return? It is important that such course should be pursued as will make the most productive cow, provided the constitution is not overtaxed. The quantity of milk which a cow will yield depends on the nature and amount of food she consumes, the power of her digestive capacity, and the degree to which the lacteal organs are developed, and their activity. The development, and especially the activity, of the lacteal organs is influenced by various causes; and among these is their being developed by use while the animal is young and growing, its tissues soft and pliable, and the habits not yet formed. My opportunities for observing the effect of beginning to breed at different ages have been better among sheep than cattle. With sheep I am convinced that the longer the ewe goes barren the poorer nurse and mother she makes. So far as I have been able to notice the matter among cattle, the same rule holds good. There is no doubt that cows are often stunted in size by being put into the hard work of the dairy while they are yet very small and immature. But I think that if the heifer is well fed, and has reached such a size as she ought to have, she should begin to breed at two years.

## PRESERVING THE HEALTH.

Beyond the use of a few simple remedies, there is no use in trying to doctor sick cattle, certainly not by any other than an educated and experienced physician. There is great difficulty for even them. The preservation of health by protection from exposure, regularity in feeding, protection from taking cold at calving, and timely attention and

care, will be found more effectual than medicine. The watchful farmer will notice each animal every day, and note whether it fills itself and is thriving. Every animal is liable, at times, from various causes, to get off its feed and to "run down." A few messes of light, nourishing food, at such times, fed so that the ailing creature can eat in peace and security, will make a great change in its condition, and put it to thriving again. Smaller and weaker animals often fail to get their share of food or drink, and so get off their feed and discouraged.

The raising of roots of some kind, for winter feed of stock, no farmer can afford to neglect. Lane's Improved Sugar Beet is very nourishing. The sweet German turnip is very hardy, productive and nourishing, and very easily raised. Our winters are too long to keep cattle on dry feed. In my opinion, the farmer who winters a dozen or fifteen head of cattle should devote an acre to roots, and can raise no other crop which will pay him so well for the labor and use of the land. They assist in the process of digesting dry food, and give a healthy tone to the system.

The care of the feet, where the soil of the pasture is wet, and on any soil during such a summer as the past, should receive seasonable attention. An application of Dr. Nichols' saturated solution of carbolic acid, once a month, will often save much trouble and loss.

The exhaustion of phosphate of lime from the soil is already beginning to show its effect on the cattle of the State. The bony structure cannot be built up and maintained without plenty of this material in the food. I am inclined to the opinion that the trouble, in some sections, from abortion, is caused by the deficiency of phosphate of lime. The use of raw bone meal, fed to stock, is ineffectual. It is not in the right condition. Applied to the soil in that form it is very

slow in operation. It should be dissolved, and the soluble phosphoric acid applied to the soil. Farmers have been cheated so much in superphosphates that many have lost faith in that kind of fertilizers. It is necessary, of course, to procure an honest article. I have always had good success in the use of superphosphates. The Green Mountain Soluble Phosphate has given the best satisfaction on my soil. I believe it is an honest and reliable fertilizer, and worth the money it costs.

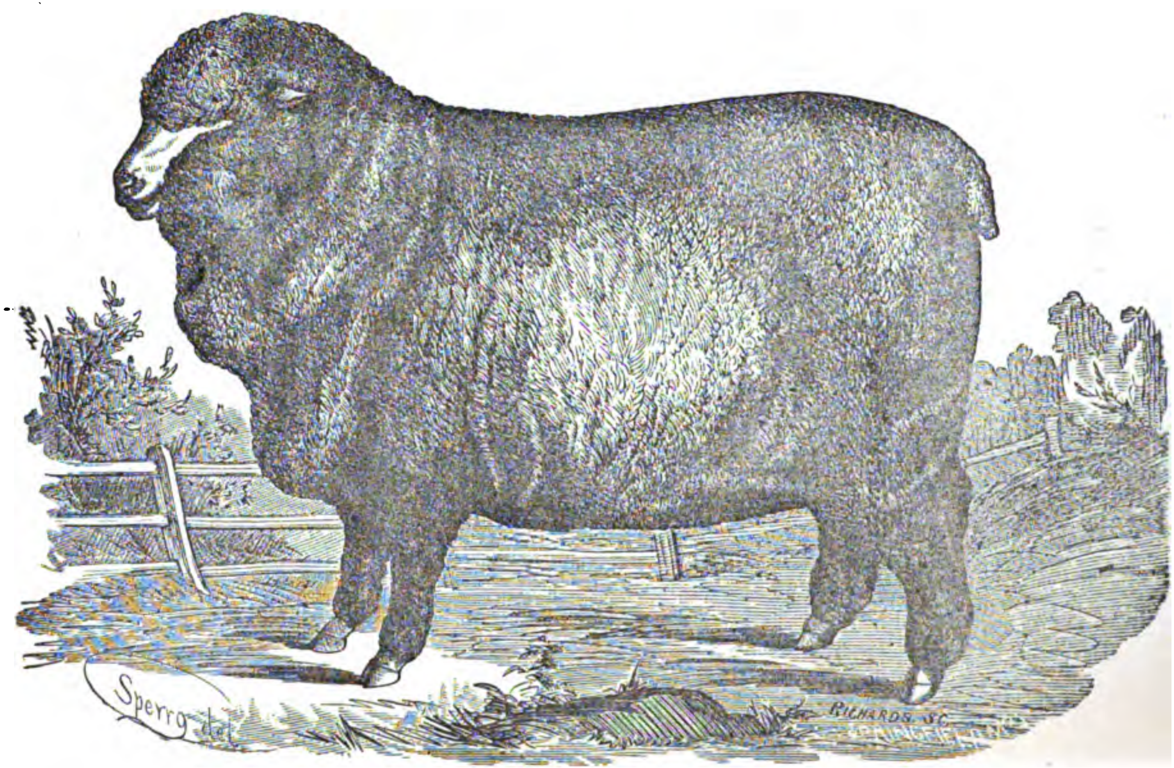
### CULTIVATION OF GRASS ON STOCK FARMS.

In order to enjoy success in stock raising or dairying here in Vermont, the farmer must give more attention to the raising of grass. With abundance of good, sweet feed in pastures and heavy crops of hay, to be fed to improved cattle, Vermont can compete with the world in raising cattle or in the dairy. To gain this success the soil must be kept in a high state of cultivation. The grain crops rob the soil very rapidly of the fertility that is needed to make good crops of grass. If farmers would quit raising grain, they would find the mowings would hold out to give large crops of hay much longer, and the quality would be better.

### CONCLUSION.

As I have already occupied too much time, it is necessary to omit much that might be said. I desire, in conclusion, to urge farmers to make improvements in stock, and to increase the fertility of the soil. There is no profit to be made in raising inferior stock, milking ordinary cows, or in raising light crops. While the farmer who is satisfied with this kind of farming derives no profit for the use of his land, and is barely paid for the labor he performs, he who, by enterprise and judicious improvements, gets heavy crops from

his land, which he feeds to improved cattle, is sure to make a fair profit in the most unfavorable season. Let us, then, brother farmers, persevere in the work of improving the cattle of the State until all our hills and valleys are grazed by the best cattle in the world.




**VERMONT MERINO.**

***Property of C. Horace Hubbard, Springfield, Vt.***

# FARM BUILDINGS AND THEIR RELATIONS TO SUCCESSFUL HUSBANDRY.

READ AT RANDOLPH MEETING OF THE BOARD OF AGRICULTURE, BY ZUAR E. JAMESON, A MEMBER OF THE BOARD.

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The opinion is commonly held that the first care of the successful farmer should be to make his soil fertile, as the crops that yield abundantly will furnish means to build houses and barns and fences. On the other hand, good buildings do not originate an income, although they give him great opportunities to increase it, and every farmer should consider it desirable to have a good house, the home of his family, and a good barn, the store-house of his wealth.

The farms differ so much in general characteristics that the proper location for the building is a subject that requires much thought, for after they are once established, all additions, alterations and improvements add to their permanency and make their removal more difficult. In location they should be central in relation to the work to be done. If the road only passes through a corner or end of the farm, do not feel obliged to set the house there, far away from fields, pastures, and woodlands, for while you may not use the road once a week, think how constantly you follow those cart ruts with incoming loads of hay, grain, potatoes, wood and lumber, and outgoing loads of manure,—how much more economically farm work can be done if it is near by. The time

of men and teams is not all occupied in useless travel, and the morning and after supper hours are used advantageously. From a central location the farm is kept more fertile. It is the distant portions that are neglected and become barren. If hired help is employed, they can be directed and worked much better from a central point than from the extreme edge of the farm; therefore, do not put too high a value upon the road. Select a dry location; it will probably be a slight elevation, giving good drainage, pure air, freedom from fogs and miasma, giving good grounds for ornamentation, fruit and vegetable gardening. The most careless observer approves of the dry and elevated location; but at the same time consider the chances for a good spring of water, a well or place for large cisterns, for an easily accessible and abundant supply of water should have more influence than the road in deciding the building site.

The second consideration in regard to the house and barn is to have them warm. Not that heat can be generated by any mode of construction, but thoroughness in building enables us to exclude currents of air, and retain heat generated by stoves or animals. The great objection to Vermont is, "it is cold." About nine months in the year we enjoy some artificial heat, yet if crevices exist around doors, windows and through loosely constructed walls, it enhances the cost of living and destroys much of its comfort and pleasure. Warmth in the house cellar is important; it is the store room for the most perishable farm products, and those highly valued for food. The embankment of earth on the outside of a thoroughly built cellar wall should be nearly to the sill of the house and well turfed over. Inside the main wall there should be lath and plastering or brick work from the sill to a shoulder in the wall below frost. Then one of the chimneys should start from the cellar bottom, and so arranged

that a stove could be set up to drive out intruding frost. A deep cellar, divided into rooms, will average warmer than a shallow one not divided by partitions. The exclusion of cold air should be possible without the annual banking that is put around most farm houses in the fall. The house should be so finished as to be tight. To accomplish this, paper, either tarred or otherwise prepared for building purposes, can be advantageously used between floors and between boarding and clapboarding on the walls. In a new building at Brandon Scale Manufactory, June 9th, such paper was being used between the two thicknesses of board composing the floor. In my house it is between the clapboards and rough boarding; others use it upon the roof and shingle upon it; but however such paper is used, and however well nailed the boards may be, the house is often cold by the neglect to perfectly finish some portion where house and wood-shed are joined, and the cold gets in around chamber or attic, and settles down around all the rooms as soon as the fires get low. This fault is often found in farm houses. How soon the thresholds of the doors are worn away. Double windows assist in excluding cold, and are often used. Double doors, that is an extra one, close fitting, hung upon the outside, will prove very useful. The common objection to Vermont as a home, on account of the severity of the climate, is partially overcome. A house and cellar that can be kept at a comfortable and proper temperature will enable us to bear our severe winters without inconvenience, and however tight a house is, it is easy to give sufficient ventilation in summer or winter, so the air will be pure and the warmth not oppressive.

In regard to warmth in barns, it is only expected that they may be so constructed that wind shall not blow through them; that the air enclosed in their walls be not easily and

constantly replaced by cold currents from the outside. When this is accomplished we call it a warm barn. To ensure this condition, the whole structure from foundation to ridge must be built with care and skill. Where live stock are kept in a barn of this kind, the temperature in winter will be higher inside than outside, and not unhealthy, and as the warm air rises the cold air rushes in at the base. Usually below the sills there is but little protection against cold. The stone work, if there is any, is of the rudest possible character and full of crevices. Many barns rest upon stones placed under the ends of the posts, the intervening places being vacant or loosely boarded. In barns that are used for storing hay and grain, no pains need be taken to secure tightness except in the roof, but all stock seem to thrive best in tight stables. Cows give more milk, young cattle grow and fatten, sheep shear more wool, and those cows that are so poor in spring as to require help in getting up will generally be found in stables where the snow blows in and the frozen manure has to be chopped up with an ax; and sheep that yield the most pulled wool are not those that have warm stables.

Since cellars have become appreciated under barns, more attention has been paid to tightness below the sills. Very few men consider cellars objectionable, and those usually have never tried them. Usually the manure accumulates in them through the winter, dropping through the floor of the stable in the first story, or thrown from the basement into the manure pit. The odors arising from the manure as it slowly ferments may possibly affect the hay. Some claim it will pass through a tight double floor and injure hay stored above, saying that, if water will run through and pass down, air and odors will pass up; but such a conclusion does not follow, for while water will go down through a barrel of

ashes, air cannot rise through them, neither will air perceptibly pass through saw-dust around ice, or thick woolen goods, while water passes through. I judge that more hay is injured in the bottom of bays by the damp exhalations from the earth passing into the hay as it lays in positive contact or only separated by a scanty open floor. I have visited scores of barns belonging to good farmers, and the most noted stock breeders, and never yet saw one so tight as to be an injury to the health of stock kept in them.

Convenience in a house or barn consists of such an arrangement of apartments as shall in the greatest degree expedite the work done therein. The wants of thousands of farmers are so very similar that we should naturally expect there would be great similarity in their homes, but instead of this we see a complete diversity. The skill of the practical architect would often be a great help in planning a new home, but they are usually planned by persons who build for the first time. Without specifying particulars and details that must always be left to the proprietor, and regulated by his time and means, we would say that convenience in a house depended more upon the way rooms are finished than upon their number and size. In every manufactory where a large amount of work is desired from each hand, he is placed were all the tools used by him are within reach, and as the men work with their hands and not with their feet, they take but few steps, while their hands are exceedingly busy. Now we do not desire that our wives be thus busy, but we *do* desire that they be required to take no unnecessary steps to do their work, and that one hour's work shall not by inconvenience occupy two hours. The wood, water, provisions, crockery, laundry, chamber work, &c., must be dealt with every day. But time will fail me to speak upon this topic as relates to the house.

Convenience at the barn requires room not only for the storage of crops of different kinds in different places, and standing room for cattle and horses, but several rooms and pens for young animals, the increase of the flocks and herds. Any listener will understand this who has visited several hundred barns in April, and seen calves, sheep and lambs, sick cows and colts in the barn floor or in the end of the bay. If an animal is ailing either from accident or ill treatment, the barn floor is the general hospital. In this miscellaneous grouping, cases have occurred where valuable sheep have been messed with the skalawags of the flock, and contracted disease from them. Calves, the stronger and weaker together, cannot be equally thrifty.

A convenient grain-box and root-cellar are great aids, for I find if a place is prepared for anything it has a tendency to set in motion a plan to have the place occupied. To feed roots with pleasure, they should be near the stock. To ensure shelter for tools, the shed for them must be easy of access. If all stock should be sheltered during storms, the stable room must be ample. And to save the fertilizers that accumulate at the barns, by introducing absorbents, and properly mixing and pulverizing, there must be care taken so that this heavy work may be as light as possible, and done at a moment's notice.

Beauty is the last topic I design to notice. It is easy to see that there is a connection between the amount of comfort on a farm, and the location, warmth and convenience of the buildings. Is beauty equally important? Let us consider it. It should be combined with the first three requisites and in addition to them. If a place is for sale, the purchaser receives an impression, either favorable or otherwise, as he approaches the buildings. He receives another impression as he goes from room to room, and looks out

from the windows upon the scenery that will ever greet his view unless altered by his labor. The picture that rises in my own mind is of a house several rods from the road, on rising ground. The drive approaching is shaded by trees upon both sides—the house surrounded by a smooth, green turf, free from rubbish, with an occasional flower-bed cut in the turf, and a few evergreen trees of perfect pyramidal form scattered about the grounds. The drive leading with a curve to the door of the house and then to the carriage house. No fences to be allowed across the ground or near the house. The nearest fence marking the extent of the grounds and enclosing them. The house and barns to be kept from manifest dilapidation, having nothing about them showing the neglect of ordinary care. The elements of beauty are such that nature can aid us. The decorative skill of the carpenter with his curiously cut pine boards, or the costly work of the marble cutter or bronze in vases, statutes or figures of animals, is not necessary to improve the farm house and give it an attractive, peaceful and home-like appearance.

Having erected the buildings where I live, I am tolerably satisfied with their arrangement, only regretting their near proximity to the road. I have to mourn the destruction by fire this month of a fine belt of trees a few rods west of my house, which was an effective wind break, a home of birds and a thing of beauty. During the infancy of Vermont farming, trees were regarded as undesirable. The labor of the farmer was constantly directed to their destruction. Now, the very general impression prevails that a few trees are desirable in the grounds about the buildings. In some cases they are planted to break the force of prevailing winds. Others plant maple trees with a view to their future use in

sugar making as well as the present ornamental. Others plant for shade.

When the subject of the departure of the young people from the farm is considered, it is advanced as a common argument that homes must be made more attractive. I doubt the soundness of the argument, as the same young men accept the miner's life in California, or the pioneer's life in the extreme west, or go to the city and work in manufactories in grease and dirt, accepting as a home a small, ill-kept room in a boarding house. They do not go to scenes of greater beauty or less work. The same holds true of many young women. Life in a factory or as clerk, or as operative in other pursuits, is not surrounded by more beauty than on the average of Vermont farms. They go for money. As long as fathers seek distant investment for surplus funds, so long it is best for sons to go where the money is invested and where it circulates, and the amount that goes from Vermont is enormous. Yet beauty about farm buildings has a commercial value. A man that fits up a gem of a place for his own enjoyment easily finds a purchaser when it is necessary to seek one. Doubtless the time will come when there will be an immigration to Vermont, when our fertile valleys will all be occupied by well cultivated farms, and a rivalry be manifested in the adornment of homes, that are not adorned to advance their price, but to add to the enjoyments of the occupants. Let the farm be well tilled, a bountiful harvest ensured, and the buildings such as shall preserve their products and contribute to their economical, profitable and pleasurable consumption.

Mr. Foster combatted the idea of beginning the chimney in the cellar.

Mr. Jameson gave as reaso

ble against extreme frosts, and also that the cellar may be ventilated.

Mr. Foster objected to storing roots in a house cellar, as being injurious to the health of occupants and to the durability of the timber of the house. He spoke strongly in favor of consulting the convenience of the female members of the family in the construction of a farm-house; also in favor of using the best and pleasantest rooms of the house for the family, and not reserving them especially for visitors.

Mr. A. B. Halbert, of Essex, (member of the Board,) opposed barn cellars as injurious to stock, and destructive to the timbers of the building, giving instances. If a cellar is built, great care should be taken for ventilation.

Dr. Hoskins, of Newport, spoke with emphasis of the importance of cleanliness about buildings, and the necessity of disinfection of stables and outhouses, which can be effectively accomplished by the use of dry earth.

Col. J. B. Mead, of Randolph, advocated barn cellars, providing abundance of absorbents and deodorizers. If this is done no injury will arise.

# BIRDS, IN THEIR RELATION TO AGRICULTURE.

READ BEFORE THE VERMONT STATE BOARD OF AGRICULTURE, JUNE, 1871.

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That all may have as complete an understanding of the subject as may be, let us say a few words in regard to the zoological characters and positions of birds, not so much for the sake of bringing forward anything new, as to revive in the memory facts already known. Birds may be scientifically characterized as air-breathing, warm-blooded, oviparous vertebrates, fitted for aerial life. Probably no group, of equal rank, in the animal kingdom presents so great uniformity in its essential characters. Among all the hundreds of differing tribes of the feathered race we find no such strange and aberrant forms as we have among the mammals in the winged Bats or the finned Whales. It is true that all birds do not fly, but they do all possess wings of some sort, though they may use them only as fins, as do the Penguins, or aids in running, as do the Ostriches.

Intense activity characterizes all the functions of the body as well as a great efficiency. Nowhere else do we find so complete a respiratory system, for, besides the purification of the blood in the lungs, the capillaries meet the air in

sacs, which are distributed in various parts of the body. These are chiefly to make the body light, but they also assist the lungs in their work. The bones are all very compact and firm; those of the neck move very freely, allowing motion in all directions, while those of the back, to which the wings and legs are attached, are fastened together so closely as to be almost immovable. The one main purpose and aim in the plan of structure seems to be fitness for flight. The firm muscles, the quickly beating heart, the light, compactly built body, the energy of all the parts, unite in the accomplishment of this end, and so effectually do they fulfill their mission that the speed and power of flight in many birds are very great. The Hawks and their allies can fly from eighty to one hundred miles an hour, their swoop being much more rapid; and many of our smaller birds, as the swallows and warblers, fly almost or quite as rapidly, and not only is their flight so swift, but they can keep on the wing for hours, or even days, with little or no rest. The eyes of an animal moving so constantly and so rapidly must have a different structure from that of man or other animals that move more slowly, or it could not accomplish its purpose. Accordingly we find all the parts of a bird's eye freely movable, and controlled by muscles. The eye of the Hawk, which lies flattened and far sighted as the bird sails slowly along the upper air, as soon as any prey is descried far below it, has every muscle ready for action, and as the bird sweeps down with the speed of wind, not only do the wings perform their part, not only do the talons and beak prepare for action, but the eye is all the time being drawn out round and full, and when the earth is reached it is as keenly near sighted as it was far sighted an instant before, and if the bird chance to turn toward the sun the third eyelid, the silvery nictitating membrane, springs over the eye and shields it from harm.

But, however interesting the structure and action of the various parts of a bird's body, an extended consideration of them is foreign to our present purpose, and so we pass on to notice very briefly the relations of birds to other animals. In their mode of reproduction and in the structure of some parts of the body birds have some affinity with the reptiles, but in other respects there is a greater resemblance to the mammals. Between these two classes, though not in all respects strictly intermediate, the birds are placed. There is no necessity for giving in this place a detailed classification, and we will pass this part of the subject by simply stating that many naturalists arrange the birds in two groups, one embracing those that hatch the young in a weak condition, and so are obliged to feed and care for them for some time, as is the case with the Robin and other of our common song birds; the other group embraces such birds as the Partridge and our common fowls, whose young are able as soon as hatched to run about and care to some extent for themselves.

Besides this general division, some more specific arrangement is adopted. That most used by naturalists comprises seven orders which will be taken up in turn, though little need be said of most of them as they are not of special interest to the agriculturist, and one order, that of Cursores or runners, which is composed of birds such as the Ostrich and Cassowary, will be omitted entirely. At this time only those species which are found within the limits of Vermont will be noticed.

The first order to be considered, Raptores or Birds of Prey, has not very much importance from an agricultural point of view. It is true that the frontier settlers suffer not a little from the depredations of Eagles and Hawks, but in a thickly settled country such losses are not usually very

large; still these larger birds are injurious just so far as these depredations extend. The Owls, especially the smaller ones, deserve more favor, as they destroy large numbers of rats, mice, moles and such animals, that do more or less damage to the crops. But more than this, they devour a great many of the large night-flying moths, which come from, and in turn produce, the large larvæ, as the potato-worm and tobacco-worm. The common Screech Owl is especially serviceable in this way.

The Scansores or Climbers are of far greater importance, as many of them are most useful. Indeed it may be asserted with truth that all of this order which are found in Vermont are friends of the farmer. In warmer countries the numerous tribes of Parrots and similar birds are many of them very mischievous, but our species are all insect eaters. We have only the Woodpecker and Cuckoos. The Cuckoos are not of great importance as they are few in number. They eat a great many caterpillars and other insects and so are beneficial so far as they go. Few birds are of so great value to the farmer as the Woodpeckers. As Wilson most truly says, this whole group seems to have been formed for the protection of our fruit and forest trees from the ravages of vermin. Among the many groundless and wholly false ideas in regard to birds is one which attributes to these birds the habit of sucking the sap of trees and which therefore bestows upon them the name of Sapsuckers. The absurdity of such an idea does not seem to have prevented it from becoming prevalent in some places. Equally unfounded is the idea that these birds eat the wood of the trees they visit. Aside from the fact that they very rarely attack those trees which are rich in sweet sap, such as the maple, but on the contrary spend nearly all their time on Apple-trees, Pines and other trees whose sap could hardly be regarded

as inviting, they visit the trees most in September and other fall months, and not so much in the spring when the sap is most readily obtained. The whole structure of the bill and tongue is against any supposition that the birds eat sap or wood. One species is however an exception to these statements. This is the Yellow-bellied Woodpecker, or sapsucker of the West. There is no doubt that the injury done by this bird has been greatly exaggerated, but yet it seems doubtful whether it is wholly beneficial, and it probably does eat some of the inner bark of trees while searching for insects. Its tongue is smooth and it differs in other respects from the true Woodpecker, but yet an examination of the stomachs of quite a number of these species has shown that their chief diet is probably insects. It seems probable that, notwithstanding the great outcry that has been raised against them in some sections of the country, this Yellow-bellied Woodpecker will yet be acknowledged as a very useful bird. But, setting aside this doubtful species, there remain six or seven other species, in regard to which there is no doubt, and which, instead of injuring the trees they visit, most certainly benefit them.

As every fruit grower knows well, his worst enemies are often the various borers. The borer is so hidden while at work that man finds it almost impossible to prevent its ravages and very difficult to even check them, but the Woodpecker finds just where the grub is located and with its sharp chisel-like bill easily digs into the wood and, when the worm is reached, the barbed tongue transfixes and draws it out. So deftly is the work done that a very small amount of wood is cut away and no injury done the tree. It is the uniform testimony of observers that those trees which have been oftenest pierced are most thrifty. In more than fifty apple orchards examined by Wilson, the best trees without ex-

ception were those that had received frequent attacks from the Woodpecker. Many of the trees "were over sixty years old, their trunks covered with holes, while the branches were broad, luxuriant and loaded with fruit." "Of decayed trees more than three-fourths were untouched by the Woodpeckers."

Probably the most useful of our Vermont species is that called the Downy Woodpecker (*Picus pubescens, Linn,*) a black and white bird, usually not over six inches long, and another called Hairy Woodpecker, (*Picus villosus, Linn,*) which is very similar in appearance, though larger. These birds are quite common about orchards, and should be encouraged to stay. Some of the larger species, at certain seasons, eat corn and a little fruit, but the amount they take is too small to be made any account of. The Red-headed Woodpecker is more destructive to fruit than any of the others. It eats apples, pears and such fruit, always selecting the ripest and best, and it is said, besides this, to eat some corn, especially when it is in the milk. Notwithstanding all this, their proper food is insects, and there can be little doubt that they do far less to destroy, than to save fruit, for what they eat is only a small part of that they have saved from destruction by destroying thousands of insects.

Leaving this not very large but useful group, let us pass on to the consideration of a very large and important order, that of the Insessores or Perching-Birds. The species of this group are very numerous and the individuals are numbered by the thousands, and a very large number are of special interest to the agriculturist. In entering upon this part of our subject we are treading upon ground, every inch of which has been hotly contested, and even now the discussion in regard to some species has by no means ceased.

Although there is a pretty general agreement among naturalists in regard to most of our birds, those who have not made a special study of their habits and structure are by no means so nearly unanimous in their opinion. Because the ground to be passed over is contested, all theoretical views and all that is simply probable will be omitted, and only what is believed to be a fact well established and capable of proof will be presented. For this reason a careful consideration of what may be offered is desired.

Of course in so limited a space as is now at my command, I can speak of only a few of the most important species, and must leave unmentioned many others, of less interest perhaps, but yet not wholly unworthy of regard, such as the Humming Bird, Vireos, Warblers, Finches, &c. The Whip-poorwills and Night Hawks are harmless, and very beneficial, as they destroy, in common with the Owls, many of the nocturnal insects. The little Wrens are of considerable service in devouring the eggs and small larvæ of insects, many of which are too minute to be seen by man and yet they may develop into formidable enemies. Still more useful in the same way is the common Titmouse, a bird regarded by many as very troublesome, and with some show of reason, for he may be seen not rarely tearing the buds from plants and after pulling them to pieces throwing them away. This certainly looks very much like mischief, but if any one will take the trouble to examine these castaway buds, every one will be found with the marks of a worm within it, and this is the object which the bird seeks, and so, while apparently doing harm, it is really preventing a much greater evil. Not only in this way does the Titmouse prove serviceable, but in many others.

The Chickadee or Black-capped Titmouse is one of our winter birds, and after the leaves have dropped from the

trees and bushes, he may be seen carefully examining the bark and thrusting his sharp little bill into every crevice, often spending a long time upon a single branch, and thousands of eggs left during the summer by the canker-worm, apple-worm and hosts of similar pests, are thus prevented from doing harm, nor does it cease its labors in summer when the eggs of insects are not so plenty, but it still wages unceasing warfare against the enemies of the farmer. Mr. Samuels, in his exceedingly valuable work on the "Birds of New England," states that it has been calculated that a single pair of these Chickadees destroys five hundred grubs and caterpillars daily.

Probably no bird has been the subject of more dispute, or the object of as many false opinions, as our common Robin, and yet no bird is more familiarly known and none should be better understood. It is not very wonderful that when one sees his pet cherry-tree, as it is just ripening its fruit, visited from morning till evening by hungry Robins, he should set down the birds as fit only for powder, and it is undoubtedly trying to one's feelings to have the strawberry bed plundered, and the raspberries and grapes, the ripening of which has been tenderly watched, missing when the expectant owner goes to gather them. We are all very sensitive when anything affects our palates or our pockets. After all this allowance, I yet hope to show that the Robin is a most beneficial and useful bird. The cherries and strawberries show us only one very small side of the questien.

Let us consider a few facts which show what the Robin really is and what he does; some of these are from my own observation but most from various other sources. A Mr. Torvellot, living in Medford, Mass., has been experimenting for several years upon some of the American silk worms, especially upon one species. For the proper treatment of

the worms and moths he has a large tract of land enclosed and covered with netting beneath which the worms feed. Mr. Torvellot states that the various birds of the region destroyed about ninety-five per cent. of these worms, and that the Robins and Cat birds were far the most troublesome. As he felt obliged in self defence to kill large numbers of them, he examined their stomachs, and in no case found fruit but always worms alone. Yet this was all through the season, and the grounds were surrounded with Scrub Oaks and Huckleberry bushes, which were a part of the time loaded with fruit that was of course much easier to obtain than the worms. To ascertain how rapidly the birds would destroy the worms, this gentleman placed two thousand of them on an oak in the very height of the berry season, and in a very few days they were all eaten by Robins and Cat birds.

Any one that will watch the Robin closely can not fail of being struck by the diligence and activity it displays in the capture of worms. It seems to be an established fact that Robins must have animal food, especially when young. In reducing the number of the cut worms and others like them, the Robin is especially efficient. These worms crawl out of the ground during the night, and go back early in the morning before many birds are stirring, but the Robin is a very early riser and devotes his mornings to the special work of exterminating these worms, which, if allowed to increase, lay waste great tracts of country, destroying cabbages, turnips, potatoes and many most useful vegetables. A Mr. Flagg, whom Mr. Samuels quotes as one who has watched the habits of this bird for a long time and very carefully, states as his belief that the Robin is almost exclusively an insectivorous bird, and uses fruit only, as he expresses it, for dessert, never as a general diet.

This gentleman tried various kinds of food for young Robins that he had taken. To some, worms and soaked bread were given, but all died ; to others worms, bread and cherries, but most of these also died. Then he tried a variety of insect food, and the manner in which the birds picked up the insects from the bottom of the cage, breaking any hard parts, and their general treatment of the food, showed most plainly that the birds knew instinctively how to take such diet, and morover the birds grew vigorous and strong upon such food. Experiments like these show conclusively that as a rule, at least when young, the Robin *must* be fed with a variety of *insect* food or die. It is not simply a matter of choice, but of necessity, which causes a pair of Robins with a nest full of young to catch the cut-worms, canker-worms and the like.

It will be interesting to note the amount of food needed by a growing bird, and then we can judge better as to the number of noxious insects it is able to destroy. Recall, if you please, what was said at the outset in regard to the energy with which all the organs of a bird act, and it will be more easy to understand what a large amount of food is needed to supply the waste necessarily caused by such activity of the circulatory, respiratory and other functions. It seems needful for the comfort of a bird, that the stomach should be full nearly all the time. This matter can hardly be more clearly or accurately presented than by an abstract of a paper published a few years ago by Prof. Treadwell, of Cambridge, in the Proceedings of the Boston Society of Natural History, (Vol. 6, p. 396.) Two quite young birds were taken which were fed at first three worms daily. The number was increased the next day, and on the third eight were given each in the forenoon, and in course of the day one died and on examination its stomach was found to be

empty. The other bird, still strong, was given a larger allowance which increased to thirty-one worms on the seventh day. From this time the bird and its food were weighed daily. It was found in this way that not until the fourteenth days when sixty-eight worms, or thirty-four dwts., were given the bird, that it began to gain in weight. At this time the bird weighed twenty-four dwts., so that its daily food weighed over forty-one per cent. more than itself. The sixty-eight worms measured about fourteen feet. After a time the food was varied and twenty-three dwts. of raw beef were given the bird, and with it large quantities of earth, gravel and water were taken. If man were to eat as much proportionally he would consume in twenty-four hours over seventy pounds of clear beef, and drink five or six gallons of water. When the bird had reached its full size its requirements reached to about eighteen dwts. of clear meat, or double that amount of worms, the latter not being very concentrated food, and it continued to take this amount up to the time the article was presented. I am well aware that it seems impossible for the parent birds to supply the young with so large a quantity of food. But we cannot suppose that a bird would eat any more in the quiet life of the cage than when freely exercising in its natural state. If now, a Robin needs so great a number of worms, not to fatten it, but simply to keep it from losing flesh, what a great benefactor of the agriculturist this bird must be! Between two and three hundred full sized worms daily is not too large an allowance. What is true in this respect of the Robin, is equally true of all our insect eating birds, and the Robin is spoken of so much in detail chiefly that it may furnish a sample of what hosts of others do.

It is not pretended that these facts prove that Robins and other birds do not eat cherries and other fruit. It is not de-

sirable that only one side, even though it be the most favorable, should be regarded, but all the different views should be taken and compared, and thus we may hope to reach a correct result. Estimate as largely as you will the loss resulting from the destruction of fruit, and as little as you honestly can the evils which would have resulted from the ravages of the insects which the Robin destroys, and the account, when balanced, will eventually stand largely in favor of the birds. Fruits last only for a time, and the amount the Robin destroys is at most quite limited, but the injurious insects are to be found in some form the year round, and while most of the Robins migrate farther South, some of them stay all winter even in this Northern climate. It is full time this matter were considered, and the vexations on account of loss of a few cherries or other fruits prevented from avenging itself in a way that brings so great evil.

All that is needed to rectify the many errors so common, is a careful and unprejudiced examination of the question. It may be true that a person who raises small fruits as an essential part of his business, receives more harm than good, from the birds, but I find it hard to believe this, for it seems as if the injury occasioned by an unchecked increase of the canker-worms, and various other like insects, would be greater than the worst inflicted by the birds. Indeed it is difficult to see how any fruit at all could be raised if the ravages of the worms were unchecked by them, and for this reason any one who meets with considerable losses from them may console himself with the thought that in all probability he would have had none at all if the birds had all been killed a season or two before, as he sometimes wished they had been, so that all he is able to gather of his fruit is so much saved.

A bird quite as much disliked by fruit growers as the

Robin is the Cedar Bird, or Cherry Bird, so called on account of its fondness for cherries and the berries of the Red Cedar. These birds come from the South quite early in the spring, in small flocks, and remain all summer. During most of this time they live upon insects and are all the while of great service, but in cherry time they help themselves to their favorite fruit, and then all their good deeds are forgotten, and they too often fall victims to unjust condemnation. I think that nothing more is needful to secure the protection instead of destruction of these birds than for any one to watch them closely, not merely during the cherry season, but all the while they are with us, from early spring till autumn. There are many who rarely if ever see this and other birds, except during the few days, or weeks at most, in which they are injurious, forgetting entirely to look after them or to consider their habits at other times, and so great errors very easily arise.

As the Bobolink is one of our most common meadow songsters and is withal a great favorite with many, a word or two will not be out of place. So far as agriculture is concerned this bird is of less importance than many others, but yet it has some interest when viewed only in this light. In the South they are usually disliked because they pay more frequent visits to the rice fields than is pleasant for the owners, and indeed they often do much damage to crops, though they are sometimes very beneficial to the cotton, as we shall see before closing. In New England however it seems to have left its love for grain behind it, and here it eats, some grass-seeds indeed, but for the most part its food consists of beetles, crickets, grasshoppers, and all sorts of insects. They remain with us only during the warmest part of the year, not often arriving before the middle of May and leaving in large flocks early in September. Even if the Bobo-

links were not the useful birds they are to us, we could well afford to tolerate their presence on account of the joyous, tinkling warble that they so constantly give us during the first part of their stay, seeming the very embodiment of buoyant life, and he must be very melancholy who can long listen to their song without catching in spite of himself something of its cheeriness and hugging himself for very joy.

One of our common birds, and one that should be highly esteemed, is the Cat Bird, as it is one of the greatest enemies of the various kinds of insects we have. The Blue Bird is an universal favorite and deserves so to be, as besides being of a cheerful disposition it does good service in warring against the insects. The Barn, Cliff and Bank swallows all capture a great variety of the flying insects and sometimes destroy the so called apple-slugs in great numbers.

Probably very few persons have any idea what the state of things would be if birds were all destroyed, other things remaining as they now are. It can not be unprofitable for us to devote a few words to this part of our subject. There are in the state of Vermont probably not less than eight hundred species of Lepidopterous insects (i. e. the moths and butterflies,) and in the whole United States there are not less, probably, than four thousand. But leaving the rest of the states, let us confine ourselves to our own and see what results we can obtain. If we suppose the number of species in this state to be eight hundred, the increase will be something like this: each female lays on the average three hundred and fifty eggs, but we will place the number at three hundred. Now suppose that in this year, 1871, there exists only one pair of each species, there would be during the year 240,000 eggs produced which would devel-

op into 240,000 caterpillars. If half of these were females, next year we should have 120,000 pairs of insects which would produce 36,000,000 of caterpillars for 1873, and so on, so that in five years there would come from the unchecked increase of only one pair of each species 1215,000,000,-000,000 of caterpillars, or two hundred millions for every single acre in the State. It is true that as the arrangement of things now is, not one in a hundred, if indeed one in thousands of these eggs, ever reaches maturity, but the great agents of destruction are the birds. The various species of ichneumon flies and other parasites destroy great numbers however. Making all possible deductions on account of all the destructive influences, except the birds, we have left a very large figure, and if this is multiplied by the number of pairs actually living on, and, as all know, of some kinds there are thousands, the product is something appalling. But astonishing as is this view of the case it is by no means complete.

The Lepidoptera constitute only a small part of the insect world. It is indeed that which probably contains most injurious insects, but other groups are not to be overlooked. We have, for instance, the vast number of beetles, to which group belong the various tree borers, weevils and curculios ; others of this tribe devour the leaves, bark, flowers and fruit of trees and plants, and many very troublesome bugs belong to this gronp. Then among the grasshoppers, locusts, crickets and the like there are many pests. Among the flies, there are the Hessian fly, wheat fly, bot flies and others. There are in other groups different kinds of more or less troublesome insects. So that if we bring all these insect foes together, we find an army of enormous size, an army sufficient, if allowed to go on unchecked, to ravage the most fertile country more hopelessly than the wildest horde

of savages or the fiercest conflagration. Man is almost powerless to check this invading host, all his ingenuity and all his knowledge has been again and again brought to bear upon the evil, and with so small results as to be almost in vain.. To show how far man's resources avail him in this matter let me quote a fact or two from an article by Dr. Brewer in one of our popular periodicals. In 1852 the forests of Lithuania were ravaged by the caterpillars of one of the butterflies and although, aware of the danger, the landholders set the peasantry at work collecting the eggs, larvæ and adults, and used every means in their power to prevent the evil, yet it continued till thousands of acres were ruined. The total loss must have been enormous; that in a single district was estimated at $58,000,000. And yet no one familiar with their habits can doubt that had not the European Jays been almost exterminated in the same forests a few years before, much if not all this great loss would have been saved.

The loss by the May chaffers in three districts of the Hartz Mountains was estimated to be in 1866 one and a half millions of dollars, and this is not an unusual loss so far as I am aware, and yet in these same districts some of the most useful birds are proscribed.

If there is a race of beings on earth that is protected from destruction by its relations to the general economy of nature, that race is that of the birds. Vengeance swift and terrible descends upon those who will not learn that they are important, nay even necessary to the success of all agricultural pursuits. While we may be much aided by those insects that destroy others of their kind, we must rely chiefly on the birds, and in so doing we shall lean upon no broken reed. While man stands aghast at the prospects before him, as he contemplates his insect foes, the birds are ready and

eager and able to help him if only he will allow them to do so. Rapid as is the increase of insects, the birds, if unmolested, will generally keep them in check. Dr. Brewer gives an instance or two to show the efficiency of the aid birds can give, that I cannot resist the desire to quote. In the fall of 1868 there was a great cry from the Southern seaboard states that the cotton worm was ruining the crops. The worms had appeared over so large an extent of country that it seemed hopeless to attempt to exterminate them, but just at this time the Bobolinks passed along the region on their Southern journey, and, instead of as usual visiting the rice fields, they went at the cotton fields and in a few hours the evil that had seemed irremediable was removed and the crops saved. Again in the Spring of 1867 the Grasshoppers were hatching in such numbers in a part of Kansas that the crops seemed doomed to speedy ruin, but just at this time large flocks of the Yellow-headed Black Bird passed through the region and entirely destroyed the insects. Many such instances might be given, all showing the great benefits the birds are all the while conferring upon the agriculturists.

I should not treat this subject fairly if I passed over some birds of a different disposition from those heretofore mentioned. It must be admitted, I think, by most observers that there are injurious birds. And yet among these there are some, if not all, that have valiant defenders. The number of species that may be set down as injurious is not very large, but some of them are very numerous in individuals, and as they assemble in large flocks they may do considerable damage. There are common in Vermont four different species of Blackbirds. Some of these do very little damage to the crops, and do much good by destroying insects. So much evil do they prevent that in some cases where they have been placed under the ban and indiscriminately slaugh-

tered, there have followed extensive and destructive depredations from grubs and worms. But the most common of all the Blackbirds is that called Crow Blackbirds. These birds descend upon the cornfields in large flocks, pulling up and swallowing the grain with great gusto, and again when it is in the milk they tear open the husks, and prevent many an ear from ever coming to maturity. And yet with all their faults they destroy a great many insects.

As to the Crow there is considerable discussion. Dr. Brewer contends, in an article in the Atlantic Monthly, that the Crow is, on the whole, a useful bird, but other naturalists doubt the correctness of this conclusion, and it seems reasonable to believe that the Crow does far more harm than good. In the winter and early spring Crows live almost wholly upon insects, and of course during this time they are beneficial. In May or early June they busy themselves in pulling up corn, sometimes making it necessary to replant large tracts. Certainly they are none other than thieves during this time. About this same time too, they are watching the smaller birds in their domestic operations, and when the eggs are laid and the young hatched they make a meal from them. If what has been said in regard to these smaller birds be true, it is easy to see that in destroying their eggs and young the Crow is preventing the destruction of myriads of insects and so is the most harmful bird as long as he continues in this predatory work. Mr. Samuels thinks that a Crow takes about eight ounces of food daily and so he is able of course to eat no small number of birds and eggs during the season. Mr. Samuels' calculation gives, as the result of one day's work for a crow, the destruction of birds that could fairly be presumed to have destroyed during the season nearly 100,000 insects had they lived. After the corn has grown too large and the birds have flown

from the nest, the Crow betakes himself again to the search for insects and becomes a useful member of society. But, as his evil deeds are far greater than his good ones, we must set him down as an outlaw. An ingenious mode of catching these birds is given by Wilson. A live Crow is securely fastened to the ground with his feet upward. In this condition his cries are loud and frequent. As soon as other Crows fly down about him he grasps them hoping to relieve himself of the fetters that hold him to the ground, and in this way the prisoner may be taken and the trap is all set for another.

The Blue Jay is guilty of similar misdemeanors, for this bird delights to rob the nests of the Thrushes and Warblers of both eggs and young. It also devours insects, beech nuts and other seeds and fruit.

Equally as guilty of robbing the nests of insect eating birds is the Canada Jay. This bird is not common except in the northern part of the State. Mr. Samuels says that he has known a pair of these birds to carry off the young of four nests of the Snow Bird in one forenoon.

Besides these three groups, the Crows, the Blackbirds and the Jays, there are a few other birds that are to some extent injurious, and in saying this I of course do not mean that no others are ever guilty of damaging fruit or crops, but that in these the injury done is not compensated by any equivalent benefit as it is in the case of the others. The Purple Finch, though a fine looking bird, is disliked on account of his habit of feeding on buds and blossoms of fruit trees. The Great Northern Shrike, or Butcher bird, is indirectly injurious, at least sometimes, as it destroys the smaller birds and so prevents the benefits they might have brought to the farmer. But at most the really injurious

birds of this order are very few in the number of species, and except the Crow and Blackbirds are few in individuals.

Of the three remaining orders but little need be said. The Rasores, an order which includes such birds as the Grouse and Wild Pigeon, are all of them seed eaters, though also eating insects, and where they descend upon grain fields in any considerable numbers they may do much damage, but, as none of them are found in large numbers in our State, they can hardly be said to be injurious, for they confine themselves to the woods for the most part and seldom attempt to rob the fields.

The Waders and Swimmers, from their habits of life, are necessarily seldom brought under the notice of the farmer, and all that is to be said in regard to them is, that so far as known they do no harm whatever, and some of them do destroy mice and insects and so are useful, though not to any very important extent.

Allow me in closing to earnestly ask all who have read the facts and arguments herein presented to give them careful thought and to test them by full and candid observation and see whether they are true or not. It has been impossible in the allotted time to bring clearly into view *every* side of the question; much more might be said in regard to many points, but while these have been necessarily imperfectly treated, there has been a constant desire and purpose to bring out fully those points which have the most practical importance. All that could be said against the usefulness of the birds treated has been given, it is believed, its due weight, and what has been said on the question has not been, intentionally at least, overestimated. Certainly it is true that the arguments brought forward have not been adduced for the sake of any favorite theory nor out of any sentimental regard for the beauty of the feathered friends, but

simply and solely because the facts in the case seem to support them.

A great deal of sentimentalism in regard to the beautiful plumage and the sweet songs of the birds has been written, and most pathetic appeals have been based thereupon to induce people to cease their molestations. This is all well in its place. Certainly no words can describe too vividly the exqusite softness of coloring, the elegance and gracefulness of form, or the melodiousness of song of very many of our birds; Longfellow's "Birds of Killinworth" is a picture as true as it is poetical, but sentiment, however well expressed, cannot stand against real or apparent self interest, and is not a firm foundation for a plain, sober argument, and in a paper intended not to amuse but to present simple facts in their clearest light, there is no place for such things. Not to the sympathy, nor the love of the beautiful, but to the judgment and common sense is the appeal here made.

It is not at all unlikely that many who will see the statements just presented will recall more than one observation of their own that seems to conflict directly with them. While in no way intending to declare such observations incorrect, I would remind you that they may not be wholly conclusive. What has been given as a fact is the result, not of passing observations, but of careful investigation. Very naturally nothing makes one more sure of the truth of anything, than the fact that he has seen it with his own eyes. But unfortunately it is not every pair of eyes that sees what is going on with scientific accuracy, and in not a few of nature's operations appearances are very deceptive, and so the inferences drawn from them must be erroneous. Many an one looks merely at the surface of things, imagines that he has seen all there is, and acting accordingly, most resolutely maintains that he is guided by the teachings of

nature. He may see a woodpecker drilling into a tree, and infers that it is after sap, and is doing damage ; or, he sees the Chickadee pulling off buds, and so sets both these birds down as only fit for destruction, and usually includes in his list all that resemble them. Observation and reasoning of this sort are far too common, and the result of it is that thousands of dollars are lost every year.

The relation of birds to agriculture is not merely a question involving the killing or protecting a few birds, but it involves the welfare of the agricultural interests of the land, and if at this time I shall only succeed in convincing a few of the importance of the matter, and so lead them to think of it and investigate it for themselves, I shall be content.

Mr. Foster asked for information in regard to the English sparrow.

Prof. Perkins replied that they were of use in killing canker worms, but thought they were likely to become a nuisance to the farmer on account of their grain eating habits.

Mr. Jameson spoke of the destruction of insects by floods, and by open winters. In his section the birds are abundant. Man has little power to protect them from any enemies except himself.

Mr. Foster expressed the opinion that the birds in his neighborhood were rapidly diminishing in numbers, not destroyed by men and boys, but by causes unknown.

Prof. Perkins said it was probably to a large extent the work of crows.

Mr. Jameson spoke of the currant worm, the cabbage worm, the Colorado potato bug, &c., that increase without any apparent check from the birds.

# THE NUTRITION OF PLANTS.

AN ADDRESS DELIVERED BEFORE THE STATE BOARD OF AGRICULTURE, AT ST. JOHNSBURY, BY

PROF. PETER COLLIER, OF THE UNIV. OF VERMONT,
Secretary of the Board.

There are few probably aware how very recent is the history of agricultural science. To-day in nearly every State, county, town and hamlet, may we find clubs, societies and associations devoted to the advancement of that art by which all others live, and yet it was only in 1795 that a Scotch nobleman published the first book on the subject, which had for its title something then rather more full of suggestions than capable of demonstration,—"The intimate relation existing between Chemistry and Agriculture." It was half a century later before the Royal Agricultural Societies of Scotland and England came into existence; and was as late as 1838 that the Gottingen Academy offered a prize for the solution of the question, "Whether mineral matters were essential to vegetable growth." Since then, though many new perplexing problems have arisen, the one which perplexed the Gottingen Academy happily is solved satisfactorily, and I will briefly present the present state of knowledge concerning the Nutrition of Plants.

All matter constituting both the animate and inanimate world is made up of certain ultimate and undecomposable

particles to which the name of elements has been given. For example, a piece of stone or wood is found to consist of certain of these elements united together by a force known as chemical attraction. The number of these elements which have thus far been distinguished from each other, and from the union of which the universe of matter is made up, is sixty-four. Of these only a relatively small number are present in that portion of matter which makes up the vegetable and animal world. Carbon, hydrogen, oxygen and nitrogen constitute nearly the entire mass of vegetable and animal organisms, and to these four elements the name, organogens, organ-formers, has been applied. Besides these there is present phosphorus, sulphur, silicon, potassium, sodium, calcium, magnesium, iron, chlorine, manganese, and at times traces of certain other elements are observed, but the fourteen above mentioned are those which are of most importance, and those only worthy of consideration so far as agricultural science extends.

Between the animal and vegetable world it is often difficult to draw an exact line, since in the lower organisms the one apparently runs into the other, but one distinguishing characteristic pertains to each, from which we are enabled to separate the members of these two kingdoms of life. The functions of the animal result in the inhalation of oxygen and the exhalation of carbonic acid, while on the other hand the vegetable absorbs, or as it may be termed, inhales carbonic acid and exhales oxygen, their action in this respect being reciprocal. Existing as the plant does in both the earth and the air, it derives its nourishment from each, and its leaves may be regarded as its lungs, while its roots perform the function of mouth.

To understand now the principle of nutrition we may

ask ourselves first, what is to be done, and then secondly, how may we do it.

If we take a piece of wood or a grain of wheat and burn it, the greater part will go off, burn up as we say, but in every case there will remain behind a small portion as an ash. This ash, which in the wheat amounts to about two per cent. of the weight of the grain, represents the mineral food which the wheat plant derived from the soil, and which is necessary to the growth of the plant. Very many analyses have been made of the ash of wheat, and although they differ slightly among themselves, it is found that where-ever grown, wheat invariably demands and takes a certain amount of certain kinds of mineral food, and that this amount is subject to variation within very narrow limits. The same is true of all other grains, grasses, vegetables and shrubs.

We come then to the consideration of those sources whence plant food is derived, the atmosphere and the soil. 1. The atmosphere is found to consist of oxygen and nitrogen, with a small amount of carbonic acid, this latter, the chief constituent of atmospheric plant food, is the product of respiration, combustion and decay, and these causes serve to maintain the supply, so that although the vegetable world is ceaselessly absorbing and decomposing it, the proportional amount in the atmosphere is not found to be appreciably changed. Besides carbonic acid, there also is found present in the atmosphere small amounts of nitrogen compounds which by rains are brought down and absorbed by the earth.

2. The soil which has resulted through the long action of heat, cold, moisture, carbonic acid, and vegetation upon the rocks, thus effecting their gradual disintegration and decomposition, contains, as we should expect, those constituents

which were originally present in the rocks of which the soil was formed. At the present day the formation of soil and the gradual advance of vegetation from those low forms of vegetable life, the lichens and mosses, may be seen everywhere in New England.

So long as vegetation grows up and decays upon the soil, the latter becomes more and more enriched in the progress of time, but by a system of cropping the soil may ultimately become deprived of certain of its mineral constituents, and such in fact we find to be the case in many sections of country, once renowned for their fertility. To obviate this, various means are employed, and we will consider them in detail, calling attention to their scientific points.

1. The application of Fertilizers to the soil. These vary widely, and are, or should be, adapted to meet certain definite wants. Among those chiefly employed may be mentioned, guanos, superphosphate of lime, bone dust, gypsum, lime, stable manure, ashes, nitrate of soda, sulphate of ammonia, green crops, &c., &c. Fertilizers may be divided into two classes, first, those furnishing food directly to the plant, and second those which by their action upon the soil serve to liberate stores of food already present in the soil, but in an insoluble condition, and therefore, so far as nourishing the plant is concerned, in a useless state, the plant being unable to appropriate and assimilate it, since only those mineral matters find their way into the roots of the plant which exist in solution. Guano, superphosphate, stable manure, may typify those direct fertilizers, while gypsum and lime often act thus indirectly as aids to plants.

2. Fallowing. By allowing the land to lie over a season with occasional plowing, opportunity is afforded for an accumulation of plant food through the disintegration of those small fragments of the original rocks present, and the

decomposition of vegetable nitrogenous matters present, and the enriching consequent upon those constituents brought down by the rains.

3. Rotation of Crops. This depends upon the fact, first, that the necessary food of different crops is different, in that though exhausted for a certain crop, the soil may be still able to maintain a different crop. Second, that certain crops being longer rooted than others are enabled to search out and obtain food from greater depths, and thus also serve to break up and increase the depth of the subsoil. Third, that as in fallowing a few seasons elapse before the rotation is completed, thus enabling those previously exhausted constituents to again accumulate, as was mentioned under fallowing.

4. Green manuring is most valuable in that it has the advantage of fallowing, and besides the soil is enriched with that food which the crop turned in had obtained from earth and air.

Of all sources whence the farmer may derive means for restoring fertility to his lands, nothing can compare with the refuse from his stables and pens in economy or for general utility. The ruinous waste, however, to which this valuable fertilizer is subjected, demands that a little space be given to its consideration.

Of the food eaten by the animal but little remains in the body, and, in fact, when the animal has attained its growth none remains, the function of the food being to maintain vital warmth and muscular action. Each muscular exertion is made at the expense of some food or tissue consumed or wasted in the exertion. This waste is being in health constantly repaired, and thus through life old tissue whether bone or muscle or brain is giving place to new. What concerns us principally in this connection is the way in which this

effete matter is eliminated from the system. The means are twofold. First, the carbon is burned into carbonic acid, and carried by the blood to the lungs, is there exhaled into air.

The nitrogen of the muscle and the phosphates of the bony structures on the other hand are by the blood carried to and secreted by the kidneys, and pass off in the liquid excrement. That portion of the food which is not assimilated by the stomach is ejected as solid excrement. We see then that this liquid portion contains altogether the most valuable constituents of stable manure, and is composed of those elements and those only which have once existed in the animal tissue, and contains them also in that form altogether best adapted for assimilation by the growing plant, namely in solution. Furthermore it contains principally those two constituents which are most highly prized in those two fertilizers which by common consent are counted most valuable to the farmer, Peruvian guano and superphosphate of lime. The guano especially for its nitrogenous matter, the superphosphates for their soluble phosphates, both of which are present and make up about one-half the weight of the solid matter present.

In conclusion it hardly appears necessary, after the above remarks, to urge upon the farming community the importance of providing means to gaurd against the waste, which, to a greater or less extent, prevails almost universally, and although certain soils, favorably located, or the result of the disintegration of rocks unusually rich in fertilizing constituents, may for many years endure the exhaustion incident to the constant removal of successive crops without apparent detriment, still it is clearly demonstrable that sooner or later such exhaustion must follow, and it would seem the part of enlightened economy to postpone such fatal result, especially when the means are so readily available.

# THE FERTILITY OF OUR SOIL—HOW LOST, AND HOW RESTORED.

A PAPER READ AT THE MEETING OF THE VERMONT BOARD OF AGRICULTURE, AT ST. JOHNSBURY, MARCH 9 AND 10, 1871.

BY JONATHAN LAWRENCE.

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*Mr. President and Gentlemen*:

If one of the jewelers of this village had requested me to come into his shop and assist him in taking to pieces and adjusting a nice gold watch, I should not have been more surprised than I was to receive from the Hon. Secretary of the Board of Agriculture, Manufactures and Mining, a request that I should prepare a paper upon some subject pertaining to agriculture and read it before this meeting. To those with whom I am acquainted I offer no apology. To those with whom I am not acquainted my paper when read will be a sufficient reason why I should not have attempted it.

The pioneers of our State were not strictly tillers of the soil. Their first object was to subdue the forest and make for themselves and families a home. They believed, as do the pioneers of the West, that the soil was inexhaustible, and for many years bountiful crops repaid their hard and rugged toil. But gradually the soil began to fail, the crops to decrease, and the result was an inheritance to their sons of a worn out and exhausted soil.

The fertility of our soil—how lost, and how restored? Now to the question what has become of the fertile soil that existed in the days of our forefathers.

HOW LOST.

By excessive and continuous cropping without returning what has been taken from it. We all know that it was nothing unusual to take four or five successive crops from newly cleared land without returning any manurial substance whatever. Now it is only by the most liberal and judicious system of manuring that the same amount of products that was easily grown by the indifferent cultivation of the pioneer, can be realized. Another source of exhaustion is the long continued grazing of our pastures. The "cattle upon a thousand hills" have carried from them in beef, mutton, sheep, wool, butter and cheese, millions of dollars worth, returning only their meagor droppings to supply the constant depletion. The united cry from Massachusetts to Canada is that the pastures do not keep the same amount of stock as formerly. Where ten head of cattle would then thrive and fatten, now five can barely get a living.

Another and a greater source of exhaustion is the ruthless denuding of so large an area of our land of its timber. At the present rate of timber cutting, twenty years will see Caldonia County nearly shorn of its original forest; in fact most of our farms have now only what is absolutely necessary for fuel and fencing. Shall nothing be done to arrest this growing evil? Shall those who feel interested in the prosperity of the State, who do not wish to have it become a desert, refrain from raising the cry of the poet, "Woodman, spare the trees." The direct consequence of this wholesale slaughter is to expose our sloping hillsides to the sweeping winds, to be washed by the melting snows of spring and

the rains of summer, thus carrying the richer and finer portions of the soil to the lowland, and forming rich deltas at the ocean mouths of our largest rivers. These and other causes that time would fail me to enumerate are the means by which the soil of Vermont has lost its native fertility.

### HOW RESTORED.

1. By rigidly economising the manurial resources of the farm. But very few of our farmers seem to appreciate this necessity of their calling. Too many allow their manures to go to waste by exposure to the sun, winds and rains. Others still do not see the importance of saving the liquid from their stock as of equal value with the solids. The waste from the kitchen and the contents of the water closet, if properly composted, would be of greater value than the same amount of many of the commercial manures that are bought at a high figure by our farmers.

2. By composting the muck and other vegetable matter that has been accumulating for ages in our swamps and lowlands. By continual washing the hillsides are being carried into our swamps where they are at present of no value to the farm, and never will be until they are removed to the higher lands or mixed again with the soil from whence they came. And here is just where we need the assistance of the Hon. Board of Agriculture. We want samples from these swamps and lowlands sufficiently analyzed to enable us to know their value as fertilizers; with what they should be composted to the greatest advantage; how far they may be transported with profit, and how applied to the soil with the best results. Many of our farmers have drawn out from their swamps a large amount of muck. They have not had the necessary information to enable them to work it to the best advantage, and concluding that it did not pay, have re-

sorted to commercial manures only to suffer greater disappointment as a general rule.

3. Another means of restoring lost fertility is by bringing back from the ocean salt, fish, and other substances known to the farmer as commercial fertilizers. And here again we wish to invoke the aid of the Hon. Board. We have paid thousands of dollars yearly for the last six or eight years in this county alone, for these commercial manures. Some brands have given good satisfaction one year and the next they were comparatively worthless. Other brands have never given general satisfaction, and we are obliged to acknowledge, humbling as it may be, that the majority of us who purchase these fertilizers are at a loss after we have used them whether or not they were a good investment. Now if the Board of Agriculture have the means at their command to procure an analysis of the leading fertilizers offered for sale to the farmers of the State, telling them just how much they are worth as a manure, we shall be able, through the assistance thus rendered, to buy the good, (if there is any,) and reject the worthless. In behalf of the working farmers, those who till their lands with their own hands, I ask the Hon. Board to do all in this direction their means will allow, with the assurance from us that we will just whisper in the ears of our law-makers, that in future a much larger appropriation for the use of the Board must be made. The money that has been paid from this county alone, that I fear has been nearly thrown away, would have enabled the Board to analyze these compounds and give the results to every farmer in the State. The trouble has been heretofore that we wanted something to enrich our farms, and we had no Board of Agriculture to apply to for assistance, and so we have "gone it blind."

4. Another means of restoring lost fertility is the plow-

ing under of green crops, and the use of lime and plaster for top dressing. In the South cotton is called king, in the West wheat and corn are king, but in Vermont grass, if it is not king, is the foundation of all good farming. Our grass crops exceed all other crops combined. Most of our soil can be rendered fertile by plowing under what can be grown upon it for a very few years. Clover, buckwheat and other green crops will rapidly restore the fertility of our poorest soil. We should adopt the English custom that "the products of soil should go to market on foot and not in a wagon," implying that we feed out instead of selling our grain crops. No Vermont farmer should sell a pound of hay or bushel of grain until his last acre of tillage land is brought up to its highest state of cultivation. We hear a great deal said about sending our money West for corn to feed our stock. I am not alarmed at this at all. Every car-load of western corn that is brought into Vermont and judiciously fed, is just bringing so much of the rich prairie and adding it to our exhausted soil. The farmer that can get the price of his grain in the increased value of the animals to which it is fed will be making money, for the addition to his manure heaps will more than pay for the expense of feeding.

5. Last but not least the planting of forest trees for adornment and for enriching the soil. Science tells that just in proportion to the destruction of our forests do our rivers and streams dry up, drouth ensues and vegetation fails. Springs that years ago were never known to fail, are now very often dry in summer and nearly so in winter. Let us encourage the growth of forest trees. Let the young or middle aged farmer set apart ten acres of his least valuable pasture land to the growing of wood. Let no stock run upon it for a few years. Let him spend a few leisure

days each spring in planting trees upon it, and he will leave a better inheritance to his family than a thousand dollar policy in any life insurance company in the United States. Few persons are aware of the rapidity with which wood grows in this State. There are a few acres of high land about one mile from this village, almost in sight from those western windows, that sixty-four years ago grew a good crop of corn, planted among the logs, Indian fashion. The owner dying, it was left to itself. It grew up again to wood. It has been twice thinned, much good wood being taken from it, and now has 150 sugar trees to the acre that have been used as such for six to eight years. That maple grove is admired by all who see it, and $200 per acre would no doubt be refused by the owner to-day. This accidental growth of forest only shows what might be accomplished by a judicious system of forest culture. One word about forest trees for adornment. Who does not look with pleasure upon the native trees that surround many of our Vermont homes. And who does not regret the want of taste in those who having the means neglect this cheap and simple adornment. Look at the forest trees that surround many of the dwellings in this village, most of them having been planted within a comparatively short time. They furnish a shield from the bleak winds and a welcome shade from the scorching sun. The planting of forest trees tends to the enriching of the soil by preventing the washing by rains and melting snows, and the yearly growth of leaves furnishes an ample dressing to the soil.

I trust that with what may be done by the Board and other agencies, we may inaugurate a system of improvement of the soil that will result in doubling the farm products of the State within the present decade. I trust that the crude and disjointed hints that I have thrown out will

provoke discussion and criticism. If that is accomplished I shall be satisfied.

E. L. Hovey, of St. Johnsbury, said he differed with the author of the paper upon the main point. He did not believe the soil of Vermont was really depreciating. Thought the returns of all our crops refuted the idea. Our crops are larger every year, which could not be the case if our soil was getting poorer. There were exceptional cases, of course. Occasionally a man sells his grain and hay, and his farm runs down. But such men do not continue in possession long. Others injure the productiveness of their farms, but without injuring the land, by injudiciously feeding too close, destroying the roots of the nutritious grasses and giving place to weeds. I know that seven-eights of the farms of Caledonia County never produced as good crops as they do now, and they are producing larger crops every year. The speaker went on to animadvert upon various injudicious practices producing apparent, without real deterioration of the land, a dimiuntion of crops from improper management and bad farming, when under a proper system much better results might be obtained. Mr. Hovey also spoke of the injury resulting from heavy burns in clearing land, which destroyed the soil, leaving nothing but a little sand and ashes that gave a crop or two, and was then sterile forever. He also alluded to the action of the cold of winter upon spots where the snow was blown away by the wind.

Z. E. Jameson (member of the Board) made some remarks in reference to the injury resulting from the destruction of forests. It is doubtless true that the sterility of Spain and some other countries was not so much due to the absence of trees, as to man's unskillful husbandry. If upon a hill the soil is found barren after the removal of trees, we

should not attribute it to that, but to the natural thinness and poverty of the soil.

Climate may be slightly affected by local causes, but in the main the changes come sweeping over the land from a great distance; from the Arctic regions, or from beyond the gulf stream. When the philosopher upon Mount Washington finds the winds pass for hours at the rate of one hundred miles an hour, we can conclude safely that no small local cause like clearing up a few acres of woodland can prevent or aid the cooling effect of such winds if from the north. It is said that springs and brooks dry up, and so they should. At the first settlement of this country the richest valley lands were so wet and frosty that the first clearings were made on the hills and gradually descended into the valleys. The rich wealth of plant food that was preserved by stagnant water can now bless man with abundant crops if the water is removed by drainage or evaporation. I read that the English government provides a draining fund to loan to farmers to aid in reclaiming low lands.

It is said too that if the land is well shaded it matters but little whether it is by a tree 50 feet high, or one ten feet high, or by a good growth of clover or corn.

It is all very well to leave abrupt hillsides to grow wood, and if one is thoroughly convinced that a former owner was foolish in clearing land that ought to be in wood, it is perfectly proper to plant trees and correct the mistake. I believe that the wood land which has been cleared in New England has improved the climate and better fitted the land for a dwelling place for man.

N. B. Safford, Esq., (member of the Board.) I began farming about ten years ago with some land called exhausted and it was very poor. It would cut only hay enough to

winter four cattle. A friend told me that he had experienced much benefit from plowing in clover on soil similar to mine, but he said that I would not do it even if I was convinced of the benefit of it. I told him I would; if the way to make a fertile farm was to plow in the crop, it should be plowed in. No, he said, you won't do it; it is one of the hardest things to do to plow in a growth of clover that would make one or two tons of good hay. And I have found it so. I have a good man to work on my farm and when I tell him we must plow in a good crop of clover, he will urge for it to be made into hay, and sometimes it is cut and hayed almost contrary to my will. I can say this however, that I have seen an improvement in the next crop whenever I have plowed in a crop, and although my neighbors have said I was a fool to turn under a rank growth of clover, yet I believe it is wisdom to do it.

One of my first experiments was upon a piece of land close by Connecticut river. A rank growth of clover was plowed in, and winter wheat sown which yielded the next year 27½ bushels of good wheat. A neighbor, in just such land close by, also sowed winter wheat and drew the straw into the barn; he never threshed it as it was not worth threshing. I find that for winter wheat this is a good preparation. I have now ten acres of winter wheat sown. I have one piece that had grown buckwheat until it was too poor to grow it. In 1869 I sowed buckwheat and plowed in the first feeble growth and sowed again and got a better crop; plowed that in and sowed winter rye, that I plowed in; in 1870 sowed another crop of buckwheat, got a heavy growth and plowed that in. I shall seed this piece down at the same time I do a piece adjoining that has been well manured. Then I can see how the methods compare. I have no doubt that a farm can be made very productive by plowing in clover. I un-

derstand that in the Genesee Valley in N. Y., it is the prevailing practice in preparing the wheat land.

I now keep 40 cattle, 80 sheep and six horses on the farm that kept only four cattle ten years ago.

I can hardly agree with the speaker who considered burning trees upon the land injurious. When clearing my fields of stumps I noticed that in the crop some places gave a rank and much better growth than other places, and at first attributed it to the place where a stump stood, but upon a more careful examination I found it was where I had gathered and burned clubs and fragments of stumps, and the ashes resulting from that burning proved very beneficial.

I make a practice of using from 500 to 1000 bushels of ashes a year, and always with a visible improvement in the crops. Plaster with me does not prove of much advantage, but ashes on grass ground increased the crop in one case six succeeding years. Some folks say they cannot get ashes, but it is not so. They can get them by paying enough. If they can't be bought for twelve cents, pay more. The farmers from Connecticut come up to Vermont and pay twenty-five and even fifty cents a bushel, and they get the ashes, and I presume it pays them at that price.

J. P. Foster, of Barnet, said there was a scarcity of ashes. Thought all that could be had in this county was carefully husbanded and applied to the land. He spoke emphatically in favor of tree planting upon the hills which were cleared and had become unproductive. Was astonished that anybody should oppose it. Should himself put out 1000 young trees this very spring, and continue to set them as long as he lived.

T. H. Hoskins of Newport. Speaking of exhaustive crops sold off from the farm, no one had said anything of the

wood crop, which exhausts the soil of that very fertilizer Mr. Safford and others have so justly eulogized. Wood was a very exhaustive crop, and it was as great an injury to the land to sell off the wood as to sell off the hay, and could only be justified on the same grounds. Ashes contain more than simply potash; they have a large proportion of phosphates, lime, magnesia, &c. Consequently leached ashes are a valuable fertilizer.

I have used ashes very extensively, and they are my best and cheapest fertilizer. But I have had some doubts whether I have used them in the most economical manner, when I have spread them on the land broadcast in quantities of one and two hundred bushels at once upon a single acre. The results were great, but I am now inclined to be more saving, to use ashes in the hill, or compost it with muck before spreading it upon the land. I believe the highest fertility may be maintained with ashes, muck, and bone, without a particle of stable manure. Good muck contains more ammonia than dung, and when properly composted is more valuable, weight for weight. But there is a difference in muck, as Mr. Lawrence has justly said, and its value must be determined by experiment. But don't give it up without a full and fair trial. I may say that in composting muck, ashes and ground bone, I add a moderate proportion of salt and plaster, with advantage as I believe.

The subject of the unfertility of knolls exposed by the blowing off of the snow interests me, for I have such spots on my land. I believe the cause of their barrenness is the destruction of vegetation. The value of vegetable matter in the amelioration of the soil has been well illustrated by Mr. Safford's experience.

The superphosphates sold to farmers, if honestly made, are valuable, essential, but I think they might be made bet-

ter and sold cheaper, and yet leave a good profit to the makers. I want a good *superphosphate*. I care nothing for ammonia in the compound. I can get that cheaper and more abundantly in other ways, as Mr. Safford does from clover plowed in, or from clover, or oil cake, or peas, fed to stock. I advise every farmer to collect all the bones he can, burn them, pulverize them the best he can, and compost them with muck and ashes. Burnt bones can be easily crushed, and most any miller would grind them if there were enough brought to him to make it an object. Raw bones cannot be ground except with expensive machinery. You lose the animal matter in burning, but its value is not equal to the cost of grinding raw bone.

Mr. Willard of Lyndon, thought the improvement in our lands, alluded to by Mr. Hovey, was due to improved methods of husbandry, which had indeed already begun to restore what had been lost to the land by the bad farming of our ancestors. Our Lyndon hills certainly gave better crops for the first than for the second twenty years. But as attention is paid to proper cultivation they are recovering. The great questions are, how we are to get the most from our manures, how we can bring up our pastures.

Mr. Lawrence said in the old times men had to sell grain to get the necessaries of life. There was no market for anything else but grain and salts.

Dr. Hoskins observed that salts never brought a price equal to the value of the ashes they were made from as a fertilizer. It was madness to sell potash salt. It was better to buy soda soap than to make soap from ashes, although if all the wash water were used to make compost, it would not be lost. But this is rarely done.

Mr. Foster spoke strongly of the neglect of night soil as a fertilizer. It could be composted with dry earth so as to be perfectly inoffensive, and was a most valuable fertilizer.

Mr. Chadwick of St. Johnsbury, spoke in reference to clearing and burning on new land. Had recently cleared a piece of several acres. Had been very careful in burning to destroy as little of the vegetation as possible. Much of the rotten wood, &c., was plowed in, and the land was seeded down. This was three years ago, and the crop of grass was large and yearly increasing. Attributed this to the abundance of vegetable matter now decaying in the soil.

# EXHAUSTION OF SOILS.

ABSTRACT OF A PAPER READ BEFORE THE VERMONT BOARD OF AGRICULTURE, AT BURLINGTON, JAN. 24, 1872,

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[Through the courtesy of T. S. Gold, Esq., Secretary of the Connecticut Board of Agriculture, permission was granted to fill out the abstracts of the following paper, and also that upon the "Rotation of Crops," by Prof. Johnson, from the more elaborate reports of the same lectures given before the Connecticut Board and published in the Annual Report of their Secretary for 1871. P. C.]

In our older States we hear continually of exhausted soils, fields worn out and unproductive from over cropping. It is important to know what is really meant by this "exhaustion." The popular belief that the land throughout the country is becoming impoverished year by year, and that the natural effect of continued cultivation is to exhaust the soil, is untrue. All the figures of statisticians cannot make it true. Its nature has been misunderstood by writers on agriculture, and there are many alarmists who do not hesitate to say that this departed fertility is gone forever. Fields are called "worn out" when they no longer pay to cultivate under

the old system, or no-system, of tillage, and one would suppose that the world is coming to an end by the way in which this thing is spoken and written about.

It is necessary that we understand precisely what the condition of such soils is. Exhaustion consists in the removal by the crops of those elements requisite for their perfect growth which are in an available condition to be taken up by their roots. It is not an absolute exhaustion; there is hardly in the world a soil that was ever fertile that can be truly exhausted, or deprived of the mineral elements of plants. All the elements necessary to the production of a given crop may exist in soil, but not in a form which makes it available to the crop. For instance, there may be much feldspar in a soil, and feldspar contains fourteen per cent. of potash; yet, potash may be applied to that soil with good results. The reason is that the potash existing in the feldspar is not in an available form for the crop; it must be freed, and converted into a more soluble form. All soils contain all the elements necessary to a crop. The entire bulk of the soil is made up of these substances in great part, and so long as the soil exists at all, those elements are there. But though there, they may not be in such form that plants can take them up. Most New England soils contain potash sufficient for an unlimited succession of crops. But it exists in the form of feldspar, a mineral that contains 14 per cent. of potash, it is true, yet in an insoluble form; the water of the soil cannot dissolve it in sufficient quantity to supply the needs of plants. To be available, all these substances must not only exist in the soil, but exist there in a soluble form.

By exhaustion of soil, then, is properly understood, not a complete deprivation of producing power, but simply a reduction of this power below a profitable point. This is in-

deed a somewhat indefinite definition, because the point of profit is not easy to decide upon, but it is sufficient for our purpose.

What does exhaustion consist in? It consists either in the removal of certain materials from the soil, materials which serve to feed the crop and become a part of it, and which, by continually taking off harvest after harvest, become diminished in quantity, so that after a certain time there is not enough left in the soil to produce a fair crop; or else it means that the materials which may still exist in the soil no longer occur in that condition in which the crop can make use of them. We may have a soil containing potash in large quantities, many hundred pounds, or tons even, in an acre, taken to the depth of two or three feet; but if this potash exists there exclusively as an ingredient of some mineral which is acted upon so slowly by the natural process of solution that there is no available potash, as we say, nothing which the crop can get hold of, such a soil would be unproductive. Again, we may have a soil which contains but a thousandth part as much potash, but which is fertile from the simple fact that the alkali occurs there in such a state as to become available as rapidly as the crop requires it.

To cure exhaustion, we must either restore the nutritive matters which have been removed from the soil, or we must change the state of those which still exist there so that they may become available.

Chemical science has established the fact that every crop requires a variety of materials to support it. I have here a number of printed sheets, containing a table of the average quantities of the chief ingredients of our ordinary cultivated crops, of which I would like every gentleman present to have a copy.

*Average Quantity of Water, Nitrogen, total Ash and Ash-elements in* 1000 *lbs. of fresh or Air-dry Vegetable Matter.*

By Prof. Wolff, of the Agricultural Academy, Hohenheim.

| | Water. | Nitrogen. | Total Ash. | Potash. | Soda. | Magnesia. | Lime. | Phosphoric acid. | Sulphuric Acid. |
|---|---|---|---|---|---|---|---|---|---|
| Wheat, grain, | 143 | 20.8 | 17.1 | 5.5 | 0.6 | 2.2 | 0.6 | 8.2 | 0.4 |
| Wheat straw, | 141 | 3.2 | 42.6 | 4.9 | 1.2 | 1.1 | 2.7 | 2.3 | 1.2 |
| Rye, grain, | 149 | 17.6 | 17.3 | 5.4 | 0.3 | 1.9 | 0.5 | 8.2 | 0.4 |
| Rye straw, | 154 | 2.4 | 40.7 | 7.6 | 1.3 | 1.3 | 3.1 | 1.9 | 0.8 |
| Oats, grain, | 140 | 19.2 | 26.4 | 4.2 | 1.0 | 1.8 | 1.0 | 5.5 | 0.4 |
| Oat straw, | 141 | 4.0 | 44.0 | 9.7 | 2.3 | 1.8 | 3.6 | 1.8 | 1.5 |
| Barley, grain, | 145 | 15.2 | 21.8 | 4.8 | 0.6 | 1.8 | 0.5 | 7.2 | 0.5 |
| Barley straw, | 140 | 4.8 | 43.9 | 9.3 | 2.0 | 1.1 | 3.3 | 1.9 | 1.6 |
| Indian corn, grain, | 136 | 16.0 | 12.3 | 3.3 | 0.2 | 1.8 | 0.3 | 5.5 | 0.1 |
| Indian corn, stalks and leaves, | 140 | 4.8 | 41.9 | 8.9 | 1.2 | 2.6 | 8.8 | 3.8 | 2.5 |
| Buckwheat, grain, | 141 | 14.4 | 9.2 | 2.1 | 0.6 | 1.2 | 0.3 | 4.4 | 0.2 |
| Buckwheat straw, | 160 | 13.0 | 51.7 | 24.1 | 1.1 | 1.9 | 9.5 | 6.1 | 2.7 |
| Meadow Hay, | 144 | 13.1 | 66.6 | 17.1 | 4.7 | 3.3 | 7.7 | 4.1 | 3.4 |
| Red clover hay, | 160 | 21.3 | 56.5 | 19.5 | 0.9 | 6.9 | 19.2 | 5.6 | 1.7 |
| Timothy grass, | 700 | 5.4 | 21.0 | 6.1 | 0.6 | 0.8 | 2.0 | 2.3 | 0.8 |
| Maize fodder, green, | 862 | 3.2 | 8.2 | 2.9 | 0.1 | 1.1 | 1.2 | 0.7 | 0.3 |
| Red clover, green, | 800 | 5.3 | 13.4 | 4.6 | 0.2 | 1.6 | 4.6 | 1.3 | 0.4 |
| Potatoes, tubers, | 750 | 3.2 | 9.4 | 5.6 | 0.1 | 0.4 | 0.2 | 1.8 | 0.6 |
| Potato tops, | 770 | 4.9 | 11.8 | 0.7 | 0.1 | 2.7 | 5.5 | 0.6 | 0.6 |
| Turnips, roots, | 909 | 1.8 | 7.5 | 3.0 | 0.8 | 0.3 | 0.8 | 1.0 | 1.1 |
| Turnip tops, | 898 | 3.0 | 14.0 | 3.2 | 1.0 | 0.6 | 4.5 | 1.3 | 1.4 |
| Carrots, roots, | 860 | 2.1 | 8.8 | 3.2 | 1.9 | 0.5 | 0.9 | 1.1 | 0.6 |
| Carrot tops, | 808 | 5.1 | 26.1 | 8.7 | 6.0 | 1.2 | 8.6 | 2.1 | 1.5 |
| Hops, entire plant, | 250 | | 74.0 | 19.4 | 2.8 | 4.3 | 11.8 | 9.0 | 3.8 |
| Hops, the cones, | 120 | | 59.8 | 22.3 | 1.3 | 2.1 | 10.1 | 9.0 | 1.6 |
| Tobacco, | 180 | 46.0 | 197.5 | 54.1 | 7.3 | 20.7 | 73.1 | 7.1 | 7.7 |
| Stable manure, | 750 | 5.3 | 69.1 | 6.8 | 1.5 | 1.7 | 6.8 | 3.2 | 2.8 |
| Dungheap liquor, | 982 | 1.5 | 10.7 | 4.9 | 1.0 | 0.4 | 0.8 | 0.1 | 0.7 |
| Fæces, fresh, | 772 | 10.0 | 29.9 | 2.5 | 1.6 | 3.6 | 6.2 | 10.9 | 0.8 |
| Urine, human, fresh, | 953 | 6.0 | 13.5 | 2.0 | 4.6 | 0.2 | 0.2 | 1.7 | 0.1 |
| Night soil, fæces and urine, fresh, | 935 | 7.0 | 14.0 | 2.1 | 3.8 | 0.6 | 0.9 | 2.6 | 0.4 |
| Bone dust, | 50 | 40 | 608 | | | 7 | 313 | 257 | |
| Nitrate soda, | 20 | 150 | 980 | | 336 | 1 | 1 | | 11 |
| Sulphate ammonia, | 50 | 200 | 950 | | | | | | 550 |
| Fish guano, | 76 | 78 | 219 | | | | 76 | 72 | |
| Ground kelp, | 98 | 12 | 211 | 22 | 44 | 12 | 11 | 3 | 68 |

To give an illustration with one of the substances which is absolutely essential for vegetable growth, I will take sulphuric acid, the proportions of which in 1000 lbs. of our ordinary crops are given in the last column of this table. Sulphuric acid, in the form of some sulphate, must be present in the soil. If we should remove all the sulphate from a given soil, it would be totally impossible to grow any crop or any plant there unless the sulphate were replaced. That is one of the first principles of agricultural science, which applies equally to all of the ingredients stated in the table, with the possible exception of soda, as has been established by such an amount of experimental evidence, that there can remain no doubt of it whatever. Sulphuric acid, or the sulphates, as they are found in nature, are very liable to be

removed from the soil. The sulphate of lime is the form in which sulphuric acid chiefly occurs in land. This dissolves in about five hundred times its weight of water; and where the soil is so situated that heavy rains fall upon it, leach through and go out of it again, the sulphuric acid is rapidly washed away. Almost everywhere, except in the poorest soil, you find the water a little hard when you use it with soap. This hardness is due to the presence of lime, and in most cases you find the water contains a little sulphate of lime, which is the same as plaster of Paris. This continually dissolves from the soil and passes into the springs and rivers. If the soil is not porus, but of such a nature that it can hold the rain which falls upon it to a large extent, the case is different, and the loss is not so rapid as from soil where the water runs freely through; but we have in this way a constant loss of sulphuric acid from the soil.

Unless there is an unfailing supply of sulphates in the soil itself, furnished, for example, by the chemical alteration of some other sulphur compound, as iron pyrites, there will in time come to be a deficiency of sulphuric acid from this washing process alone, and although this element of crops is the least prominent of them all in respect to quantity, it is likely to be soonest exhausted. The moment when the available sulphates in the soil become less than is required for a full crop, it will be impossible to realize such a crop without making good the deficiency.

The soil in a given case may be unfertile, may become exhausted, simply because this one ingredient is removed by the process of washing and cropping. Lime and soda are also washed out from the land, slowly to be sure, but continually, and in quantities whose aggregate is very large. There are other elements, like phosphoric acid, which we do

not lose by washing to any appreciable amount. You do not commonly find this substance in the water of wells or springs, except in the minutest quantities. It is very rare to detect it in waters, except those which have passed through a very heavily manured soil, or unless it is otherwise especially abundant. Potash, for another example, rarely wastes from the soil, unless it is from light, coarse, sandy land, having but little fine material in its tilth.

If the substances which feed the crop, one or all, have become reduced in quantity or are not in proper condition as to solubility, we may remedy the exhaustion either by applying the materials in the form of some fertilizer which contains them, or we may omit that, and rely upon those processes by which the original rocks of the earth's surface have been converted into nutritive soil; the processes by which those substances, once totally unavailable for crops, have been made available. We can wait the operation of the natural agencies which are involved in what we call "weathering;" the action of water, and of the carbonic acid and oxygen in the air. When we leave land in fallow—a thing which is practiced much less now than formerly—these processes go on in the soil, and prepare a quantity of plant-food for the crop of another year. This "weathering" process is in constant progress and is of great importance in supplying the materials which our crops demand. If that process should be suspended, farming would become a very difficult business. That certain fields will produce crops of the same kind for years and years without any fertilizing addition whatever, is due to the fact, that as fast as the crop requires and removes the materials given in our table, they are supplied by the soil itself; they exist in the soil, were originally stored up there, and they are made soluble day by day, as the crop may need. The rate at which this weathering

process goes on determines, other things being equal, the natural yield in a given case. By active tillage, throwing up the soil, so that it is exposed more fully to the air, and by drainage, if this be necessary to ensure access of the atmosphere, this process can be hastened. Most saline fertilzers, such as common salt, nitrate of soda, superphosphate of lime, and plaster of Paris, also act in a similar way to dissolve the elements of the soil, and thus prepare them for the crop; so that, although these fertilizers may in some cases do nothing towards feeding the crop directly, they help to feed it by this indirect action in dissolving and bringing into an active form the materials which the soil contains in abundant quantity but in an inert state.

To go back and review, in a couple of statements: Exhaustion is the reduction of the producing capacity of the soil below the point of profitable cultivation, and depends either upon the absolute removal of certain materials, or their removal to such a point that the supply is below the demand of the crop, and such removal of materials must be compensated either by suitable fertilizing applications, or by making the unavailable materials still present in the soil available by fallow, tillage, &c.

When any soil becomes exhausted of a necessary element of plant food in a soluble state, it becomes the business of the farmer to restore that which continual cropping has taken away. A crop has been produced year after year, and carried off of the farm, which was continually removing a particular ingredient, as potash or phosphate of lime. This must be replaced, and when that is done the exhaustion is cured. For this purpose ashes and bones are applied. But oftener it is only necessary to make available the matter already in the soil. The farmer must understand the processes by which this is cheaply and effectively done.

The farmer must understand the processes by which he is to put these elements into a form which will make them capable of being taken up and utilized by the crop. Fertilizers are calculated to supply elements abstracted from the soil. Farms so situated that commercial fertilizers are inaccessible can only be restored in this way,—by fallowing, plowing under green crops, or returning a portion of the crops in some way as manure. It is not required to put back all the land yields in order to continue its fertility; that is impracticable and unnecessary. There are alterations steadily going on in the soil, weathering, pulverization, solution, that tend continually to supply plant food. The rapidity with which this naturally takes place constitutes the difference between soils as regards natural fertility. It determines their productiveness. It is the measure of their fertility. The art of the farmer is to incresse this rapidity. Fertilizing is increasing the rapidity of these changes. These processes go on slowly in unfertile soils, and if we can aid or hasten them by art we can increase their fertility. As a rule, farmers must mainly depend upon these changes for the fertility of their land. The fertilizing effects of good tillage, without manure, which are well known, depend upon these processes, which are hastened by exposure to the air, the rain, frost and snow. We pulverize the soil, and in this way admit the action of these forces upon its particles, breaking them down and fitting them for the use of crops. Among the things that then occur, besides the partial solution of mineral matter, is the formation of compounds of nitrogen in the loose soil by the process known as nitrification, or the formation of nitre, (saltpeter,) which is a compound of nitrogen, and thus an important element of fertility. Nitrogen may exist in the soil and yet not be available to the crop; nitrification is the conversion of free nitrogen

into ammonia and other forms in which it will be available to the plant.

In some dry hot climates, as in India and South America, the process of nitrification, the nature of which is not yet well understood by chemists, goes on so rapidly, and nitre accumulates so fast in the soil, that it can be extracted by leaching the earth, just as we extract potash from wood ashes. This is the source, indeed, of most of the saltpeter of commerce. In our soils this does not take place to so great an extent, but it is one of the ways in which fertility is maintained or restored by thorough tillage. On some soils, particularly those rich in vegetable matter, like the fertile bottom lands of the West, or the valley of the Nile in Egypt, nitrification is sufficiently rapid to supply all the nitrogen that the heaviest crops require. But it is not so in New England, and we have to resort to nitrogenous fertilizers, such as Peruvian guano. But one strong point in judicious husbandry is to place the soil, by tillage, in a condition for nitrification with the air.

Every one knows and it has been known for years how to convert poor into good soil. The reasons for this change have only just been and are now being learned. Every one understands that he must incorporate into the soil vegetable matter necessary to supply waste. So he uses manure from the stable, peat, muck, &c.

There are other conditions beside simple tillage that favor this nitrification, such as the incorporation with the soil of vegetable matter, litter, barn manure, green crops, muck, &c. These favor both nitrification and weathering. In agriculture as in Christian grace it may be said, that "To him that hath shall be given," for a farmer who applies such manures freely, gets the benefit, not only of the elements of fertility that those manures contain in themselves, but they

absorb more from the air, and also develop more in the soil by the solvent action they exert upon its constituents. Thus he who makes his land yield a large crop this year has the surety that he will get a larger one yet from it next year. A large crop from a field this year with proper treatment insures a larger crop next season. All the staple mechanical operations of the farm operate in the same way; tillage, underdrainage, (which knocks the bottom out, lets down the water and lets in the air,) the application of lime and ashes, as well as dung, muck and green crops, are useful even more for their action upon the soil than directly in giving food to the crop. Many fertilizers that we use act chiefly in this way, as plaster and salt. Salt is not a necessary plant food, yet it enriches the soil by its dissolving action, and sometimes will double the crop. An application of 20 bushels to the acre will be very efficient in liberating potash, magnesia, &c.

An eminent English farmer, J. B. Lawes of Rothamstead, who is farming land that has been in the possession of his ancestors for a thousand years, and has for years been doing more in careful and systematic experimentation than all other agricultural experimenters put together, in speaking of this subject defines the difference between what he calls the "natural strength" of a soil, and its "condition." By natural strength he means the feeding power of the soil dependent upon its composition; this is inseparable from it, cannot be removed, is always the same, and must always continue; a fact very consoling to farmers, and very disagreeable to that class of writers who are constantly croaking about the "permanent exhaustion" of land. Every soil has its own natural strength; there is a wide range of this; some are very fertile and keep producing the most exhaustive crops right along for ages, while others are natu-

rally weak. There are lands in the Connecticut valley to which some have denied the name of "real estate,"—blowing sands, so poor that they hardly grow the most hardy weeds. These lands have been cropped to rye for centuries, being sowed once in two or three years, and invariably give a yield of 8 to 10 bushels, without manure. This is their natural strength, and they will go on yielding the same crop at the same intervals, as long as the world stands. So in Hungary and Southern Russia, where the land has been sown to wheat once in two years, time out of mind, with a regular yield, varying somewhat with the season, but always a paying crop. Soils in Greece are known to have been in like manner cropped with barley for two or three thousand years. This illustrates what is meant by the natural strength of soils.

All production is the result of a chemical change, which is behind the crop, and is the cause of its growth. This change is like the winding up of a clock, which produces the ticking. The crops are the measure of the effectiveness of these chemical changes. They are the smile of Heaven upon the land. Among lofty mountains these changes occur visibly; the avalanches, or snow slides, are tearing the rocks, the frost rending them, the glacier grinding them to powder, to form the soil for future crops. In the soil they still go on invisibly; the stones crumble to sand, the sand becomes dust, and the dust is dissolved by the rain, and by the acids the rain brings down, as well as by those that are provided by the plants. The same processes which are going on among the Alps, in the form of avalanches, are continually going on upon a minute scale in the soil beneath our feet. If our ears were microscopically delicate we might hear the avalanches in the sand, and so, by these continual chemical actions, minute in detail but vast in the aggregate, the food of the crops is made ready.

The other quality of the soil, which Mr. Lawes calls "condition," (a name borrowed from the vocabulary of the stock raiser, and implying, when applied to the soil, just what it implies when applied to horses or cattle,) is the result of what may be called extra causes,—causes additional to the work of nature in the decomposition of soils, and capable of being supplied by human action. Farmers are in the habit of saying, " This land is in poor condition "—or, "This is good soil, but it is rather run down; it is in poor condition at present." Or, looking over the fields of a neighbor, who has taken a little extra pains, "This is poor land, but he has got it up into good condition." "Condition," then, is artificial or accumulated strength; a thing we cannot depend upon, except as we can depend upon the continuance of the artificial or temporary causes of which it is a result. "Condition" refers to those elements of fertility which are capable of being turned to account in the growth of crops within a limited time. We may have a "condition," which is the result of natural causes, as is illustrated by the manner in which Indian corn is grown in some parts of South America, on land newly cleared from the forest. You know that in tropical latitudes, the year is usually divided into two seasons—the wet and the dry. During the former, abundant rains fall and vegetation grows with wonderful luxuriance. The other half of the year is comparatively dry, and plant-life is inactive. At the close of the rainy season, the planters chop down the timber, the brush, and everything that grows upon the land where they propose to get a crop. When the fallen vegetation is sufficiently dry, they set it on fire, and everything burns completely except the largest trees. When the fire has gone out, toward the beginning of the next rainy season, they have a field destitute of vegetation and coated with the ashes of the

forest. There, with the smallest preparation, they plant their corn in the ashes, dropping it in where they can, and get a magnificent crop. The second year, they put on corn again and get another large crop. The third year they get another crop, and after that, it is cheaper to abandon that field, and to clear another. The first piece grows up to forest, and in six, eight, or ten years, perhaps, they can burn it over again. Here the fertility of the soil after burning is a "condition" which is produced partly by natural means, the growth of the forest, which brings up matters from below; and partly by artificial means, the felling and burning of the forests, restoring those matters to the surface.

When farms were first opened in Vermont the surface of the soil was found covered by a dark substance called leaf-mould, which was the source of its great productiveness. It consisted of decayed vegetable matter, and was rich in mineral substances that had been brought up out of the soil by the sap of trees, and left upon the surface by their decay. This constituted in fact a heavy coat of manure, and as long as it lasted even poor soils gave a large yield. This was "condition;" but by a thriftless system of husbandry it was soon exhausted, and the land reduced to its "natural strength." This is just what exhaustion of soil consists in; the removal of its "condition."

It is evident that we may have a *good soil* in wretched *condition*. This is the case with a water-logged clay soil. The roots of plants will not grow in it because it is too cold; it cannot be made mellow because it is wet. Drain it and till it, and it becomes very fertile—you have developed its *natural strength*. The addition of manures will bring it into still higher *condition*. Moderately productive soil may be brought to a very high condition by manuring and careful

tillage, and then run down again to its natural fertility, but no lower; and this may be, and is, done again and again. This is what is meant by worn out land. Left to itself it will slowly recover; but by skillful farming it may be recovered with rapidity.

This distinction, between natural strength and condition, was brought out on Mr. Lawes' farm by actual experiment. His land is a moderate heavy loam, of good, but not extra natural strength. In a series of experiments it was cropped year after year with winter wheat without manure. Its first crop was 16 bushels to the acre, and for twenty-eight years it continued to yield an average, without any manure, of 15⅝ bushels. For all that time it only once fell to half a crop, owing to a bad season, and only onee went above the average. This is its natural fertility. Another piece, kept fourteen years in grass without manure, averaged 2690 pounds of hay per acre. Other experiments were made as to the effect of fertilizers on plots of land directly along side of that kept in wheat. One of these was manured every year for nineteen years with 14 tons of stable manure to the acre, and averaged 36 bushels of wheat. Another plot gave the same average yield (36 bushels) when annually manured with 400 pounds of sulphate of ammonia. On these plots the straw from that dressed with stable manure averaged 3400 lbs. per acre, from that manured with the sulphate, 3600 lbs. Another plot gave 48 bushels of barley, and 2800 lbs. straw with 14 tons stable manure; 300 lbs. of superphosphate and 200 lbs. sulphate of ammonia gave an equal crop. On a plot in grass 14 tons of stable manure gave 4816 lbs. hay to the acre, while a mixture of superphosphate, potash and sulphate of ammonia produced 6648 lbs. to the acre. These dressings had to be repeated in equal amount every year, to obtain an equal yield. If omit

ted, the yield fell in two or three years to that due to the natural strength of the land. This condition may be produced and exhausted; not as with natural fertility—on the latter depends the stability of the soil which prevents ruin; the condition is all that can be taken out by what is called "skinning" the land.

Land may appear to be exhausted for one crop, and yet have fertility enough for another. The land that gave Mr. Lawes good hay would not give him a crop of turnips, neither would his good wheat land; yet an application of superphosphate without ammonia gave big crops of turnips. From these experiments it became a proverb (not applicable however to all soils,) that ammonia is the manure for wheat, and superphosphate for turnips.

Mr. Lawes found that he could not keep clover growing long on his land even with different fertilizers. He had a desperate fight, scratching in seed year after year, and trying one fertilizer after another, but had to give it up at last. The clover would not grow continually, and he found that he could only get a crop of clover once in eight years from the same piece. The result would not be the same on other land. Some soils might grow clover well and refuse to give continuous crops of grain.

Land under skillful cultivation steadily increases in value. Many farmers in Europe have done so for more than a thousand years. There is no instance on record where land has ever become hopelessly exhausted by cropping. Much land improves even when not well treated, and the most brainless farming cannot permanently destroy fertility. Wherever lands have become thus barren, as in Spain, it has not been due to bad agriculture, but to natural causes, like the destruction of forests, which reduced the rainfall and caused floods that washed away the soil of the hills and covered the

plains with sand and gravel. We have suffered from this already in New England, and there is still danger of it. We should encourage the growth of forests on hilly and rocky land. Professor Johnson remarked, in closing, that what he had said on the subject of exhaustion of soils, though not immediately practical as regards the production of crops, would yet, he hoped, be suggestive of important ideas, and have the effect to encourage these despondent individuals who were in constant fear of the total disappearance of fertility from the face of the earth.

Dr. Hoskins began with the question which is the all important one, "Does farming pay?" and said that those who answer it in the negative are generally what are called "fancy-farmers," and are not real, practical farmers at all. They are the ones who start out in agriculture with great expectations and little knowledge. Farming is the only avocation which always has and always will pay. Every other avocation depends upon it. It *must* pay. It does not pay everybody who goes into it. The amount of crop depends upon the skill with which the soil is cultivated. New England was once compelled to produce all that she consumed. With the increase of non-producers arose a demand for more than the farmers could produce, or at least supply from their surplus. It is now fifty years since competition began between New England and the West. Within less time, forty, or even thirty years ago, Maine, New Hampshire and Vermont exported grain. Many, perhaps, now present, can remember the first barrel of flour which was purchased. Our inhabitants cannot be fed by our soil.

The example of England, under protection and under free trade, was quoted. "Necessity is the mother of invention." When more is required of men, they cast about and invent new methods, and seek to acquire new means to sup-

ply the demand. So with the farmer; when larger crops are demanded, he learns to economize not only, but to make manure; he uses oil cakes to feed his cows, he drains his soil, ploughs deeper, and uses scientific means of all kinds. All this took place in England on the repeal of the Corn Laws; and book farming and scientific farming has made the English farmer what he is, the best farmer in the world. We need this lesson. We have now hardly any protection; we do not need it. We need knowledge. We must prevent the waste of the rich resources for vegetable growth in New England. The soil is nearly exhausted, and we must "root hog or die." We must fertilize with brains. Raising young stock is most exhaustive to the soil, as they take up into their bodies all the best elements of the soil, and are sold away from the farm.

It will not pay to make a poor article of butter or cheese. There is always a high price in the market for a good article. Those living near market can dispose of their milk to advantage, and so should learn the best methods of producing the largest and best quality. Grass must always be the great crop in New England; we do not know our own capacities, we are ignorant of how much hay per acre may be produced. We need more enterprise, more pluck, more energy, more thought; without these the fortune of the farmer is where the woodbine twineth. Grain farming in New England must be driven to its best to pay. The time for poor farming has passed in New England.

Mr. Safford of White River Junction supported Dr. Hoskins in the main points, and said that we must not be satisfied with ten or fifteen bushels of wheat to the acre; we must have more.

Gov. Stewart called upon Dr. Hoskins to give an account of the results of some of his own farming.

Dr. Hoskins responded by saying that there had been nothing remarkable in the results obtained by him, or anything different from what had followed the application of similar means by many who were present, as well as other farmers. He was convinced, as Prof. Johnson had said in his paper, that even our most worn soils were not in any true sense exhausted; that they need only the replacing of a few of the mineral elements that are least abundant in the soil, with good tillage, good seed and a proper after culture. Those who have heretofore cultivated the rich primitive soils of Vermont have been somewhat like the sons of wealthy men who, because their fathers have plenty, do not feel called upon to put forth all their energies. But the old gentleman's funds are not inexhaustible, as we are all learning, and now, if we are men, we will begin to reform, and do our best to restore our land. This can be done profitably, by use of the necessary knowledge, which is not difficult to acquire. With himself, the trouble had been that his land, when he bought it, had been exhausted of potash in an available form by long continued cultivation of potatoes, a plant requiring much potash. Most of these had been carried to the starch factories, which had sent that valuable fertilizer down their sluice ways into the streams, and so onward to the Atlantic. By this improvident cropping, in part, and by using unproductive, feeble varieties for seed, the crop had been reduced to 80 bushels on an acre. Principally by applying ashes and plaster, with a good superphosphate in the hill, he had found no difficulty in raising the crop the first year to 300 bushels to the acre. Next spring he had seeded the land to grass, without grain, and had not got less than two tons of hay per acre since. Evidently, this land was not exhausted, except of one or two elements.

# ROTATION OF CROPS.

ABSTRACT OF A LECTURE BEFORE THE VERMONT BOARD OF AGRICULTURE, &C., AT BURLINGTON, JAN. 25, 1872.

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Professor Johnson began by saying that he should speak of Rotation mainly in connection with the chemical principles involved in it. Rotation lies at the foundation of modern improved farming, yet it is not always strictly necessary. There are many circumstances which necessitate or justify a *Rotation of Crops*. I will not attempt to enumerate them all. Differences of soil and climate, the quantity of fertilizers accessible, the demand in the markets, ease of transportation, politicians when they make fluctuating tariffs, weeds which come to infest the fields, insects even, may make it advisable to alternate our crops. It may not be uninstructive to go back in history and give a sketch of the gradual development of the practice of rotation.

The earliest husbandry was simply pasturage. When the people of temperate climates found they could not support themselves by killing wild animals and gathering fruits, the natural produce of the country, they began to tame animals and keep herds of cattle, sheep, etc.; and you know that on the vast plains of Asia and South America, this sort of pas-

toral husbandry is still the only one known. As population became more dense and land more valuable, people crowded each other, and there was not room enough to roam about at will and settle upon pasture wherever it could be found, unless, for a change, the people fell to fighting, and partially killed each other off, thus leaving land enough for the survivors. When civilization began, it became necessary to cultivate forage crops, or, at least, to take some care of the natural meadows. The next step was to assist these natural resources by growing some grain, and the people began to break up a little land, and cultivate wheat and the various grain crops; afterwards, attention was given to root crops. It may not be possible now to show how these steps of progress have taken place in any given locality, but this is a general history of the development of husbandry all over the world, wherever it has attained any perfection. Farmers have always carried on their operations in a very simple way, at first, for many generations. But when it became necessary to keep a portion of the ground in continual cultivation, it was found that grain crops especially would not succeed without rotation. The first step towards rotation was what is called the "naked fallow," in which the ground was left idle one year, with perhaps occasional plowing to destroy weeds and mellow the ground, and sown with grain the next, and so on alternately. On the continent of Europe, where we have the most authentic accounts, they plowed a small portion of land, and grew some grain upon it—barley, wheat, or rye—putting in the same crop as long as they could make it grow and get back a little more than the seed. They were content with much poorer crops than we regard profitable. They used the same land for several years, until its "condition" was gone, or until it was no longer remunerative, and then they left it and plowed up

another piece. The old field would grow up to grass, and after a number of years they would come round to it again and sow it to grain. That was the earliest and simplest plan of conducting farming. In those days there was but little skill or thought bestowed upon agriculture. The intelligence of the world was mainly given to government, war, and things of that sort. The peasant was a man who knew nothing except to grub the ground, and he did it year after year, generation after generation, as his father had done it before him, with little idea of change or improvement. In the neighborhood of cities, where there was better pay for this kind of work, and more intelligence concentrated upon it, of course it began to be found that a little rotation was a good thing. Where rotation started we do not know. In some books it is stated that it was invented in England. But if you will read Virgil and Varro, you will find that the Romans were well acquainted with rotation, although Virgil, who was a poet, only mentions it in an incidental way. Leaving the results of modern science out of the account, there is not much in our agricultural practice that you will not find described in Latin books. Those people who developed a magnificent civilization which they forced upon the unwilling savages of Britain and the north of Europe, who were our ancestors, did a great deal of good work in the way of agriculture, considering the facilities at their command.

After a time, there came into use in Europe a system which was practised there extensively in the ninth century, and is still followed in some parts of the continent. It was known as the three-course system of rotation. For centuries this system was carried on where the farmer had large pasturage, and little plow-land. The first year, the plow-

land was left in fallow, but in the autumn was prepared, by what manure and rough tillage could be given it, for a sowing of winter grain, mostly rye, which occupied the second year. The third year the ground was put in summer grain, which completed the shift. Then the farmer began again, with a year of fallow and manure, a year of winter grain, a year of summer grain; and so he went on—three years—three years—three years—indefinitely. I suppose there are districts in Europe that could be pointed out where this practice has prevailed for nearly a thousand years, and it was early imported into this country. It was the subject of legislation in the time of Charlemagne. Some historians think that this monarch decreed the adoption of the three years shift; others think that he merely recommended it, as an improvement on what had previously been the custom among the less advanced peasants, of simply using the plow for a succession of years, without any rest for the land. Up to this time the cultivation of forage was unknown. Under the three-course system the support of domestic animals was dependent entirely upon pasturage. When the growth of forage was begun, a four-course rotation became necessary. For this purpose clover was introduced, and the growth of this class of plants dates back only about one hundred and fifty years in England. In the vicinity of cities, where the plowed land increased in proportion to the quantity of pasture, and the supply of dung became inadequate to manure it sufficiently, so that the manure and fallow together could not make two good grain crops, forage plants—grass, clover, or roots—were introduced into the course; and in that way, a great variety of rotations came into use.

In England, there has been practised, over a considerable part of the country, what is known as "the Norfolk rota-

tion"—a four years shift. You have all read of it, doubtless. The first year, clover and mixed grass seed; the second year, wheat; the third year, turnips or rutabagas; the fourth year, barley; and then the same course again, with perhaps a little variation; perhaps the land was kept two years in clover and grass. In Dorset, Wilts, Essex, Herts, Suffolk, and Cambridge, in England, ten or fifteen years ago, this course was in almost universal use. I speak of this matter to bring up one point. There are certain advantages in rotation which being observed or conceived led to its adoption. But farmers, especially in long-settled countries like England, are apt, having once accustomed themselves to a routine, to adhere to it long after its advantages cease to exist. This is illustrated by the fact that Norfolk, which gave England the four-course system just described, began more than thirty years ago to amend its own improvements. The command of concentrated and artificial fertilizers, which admit of easy application at any point in a rotation, led some of the best farmers there to introduce another grain crop—oats—into the shift, making a five years course, and according to Caird, in his "English Agriculture," "on a large farm where this system has supplanted the four years course, the average produce of all the grain crops has increased in ten years between thirty and forty per cent.; the extent of land on this farm in wheat having during that period annually increased till it has now (1850–51) become one third greater than it was then."

In Great Britain, Germany, and other European countries, you will find in many localities very complicated systems of rotation. I saw the other day, in a book which I was looking into for some statistics, a long and curious calculation, showing the various materials—lime, potash, phos-

phoric acid, &c.,—taken off and put on a farm, which was divided into ten equal fields, and these fields went through successively with the same ten years' rotation; which was: 1, Summer Fallow, manured. 2, Winter Coleseed. 3, Wheat and Rye. 4, Legumes, manured. 5, Rye. 6, Potatoes. 7, Clover and Grass. 8, Clover Hay. 9, Pasture till 1st of July, then Summer Fallow. 10, Rye and Wheat, "half manured."

It is a great advantage, in the conduct of a large estate of four or five hundred acres, to have the whole system of cropping made up beforehand, so that the men can tell just what is to be done from year to year. The management of farm labor is simplified by this arrangement. That is one of the reasons why such complicated rotations are adopted.

The reasons for any particular rotation depend upon the particular character of the soil, convenience to markets, and the adaptedness of different crops to succeed each other. They are modified by the effect of tariffs, the cleanness or foulness of the land as regards weeds, and various other reasons. It is not impossible to grow some crops on some soils continually, without rotation. Barley has been grown uninterruptedly in Greece, on sandy soil, for 3000 years; wheat in Egypt for a still longer time; so corn has been grown in Mexico and rice in China and Japan, sometimes with fertilizers and sometimes without. But the tendency in nature is toward rotation. The vast oak forest in which Charlemagne once hunted is now a pine wood. We see the same tendency in our own country. When the spruces of the Adirondack woods are destroyed, the white poplars take their places. There is an adaptation of plants to succeed one another, owing to different habits of feeding, the same as is shown in animals. We know that we can keep more animals of different kinds, cattle, sheep, and horses, than we

could of a single kind—one takes what the other rejects, and some feed closer than others. We rotate our animals in the pasture. So with plants.

It should be well borne in mind that while there are circumstances in which rotation is extremely advantageous, there are other circumstances under which it is comparatively unimportant. Certain conditions make rotation necessary, and others make it unnecessary.

There are two kinds of farming, both of which may be practised on a scientific basis, yet differing in principle. One may be styled "Intensive," and the other "Extensive" farming.

Intensive farming may be practised in the vicinity of cities, or in densely settled districts, where the markets are good and fertilizers abundant. In intensive farming manures are applied abundantly, and the condition of the soil constantly kept at so high a pitch, that the same crop can be grown successfully year after year. Here a true rotation is not required, though a change of crops occasionally may be advantageous.

Extensive farming, on the other hand, is suited to a region where land is cheap, labor scarce, and capital small. Here rotation comes in as an indispensable adjunct of good farming. In principle it depends upon the facts explained in the previous paper upon the "Exhaustion of Soils," where it was shown that when the soil has been temporarily exhausted by one crop, (say roots,) of the materials necessary to its perfect growth, another crop, (say grass or grain,) requiring to some extent different materials, might succeed it and yield well.

Now I wish to state some of those principles which should govern us in rotation, so far as this depends on what we may call the chemistry of the crop and the soil. So far as

the feeding power of the soil is concerned, the special requirements of the crop should determine the rotation. Of course there are other conditions to be taken into account in practice. Winter wheat, for example, cannot follow itself beyond a certain length of time, even if the soil will allow, because the land ordinarily becomes foul with weeds; and it is better to alternate with some crop which will enable us to destroy the weeds by hoeing, or which will choke them out directly. There are many conditions which influence rotation that I do not propose to speak of, but I shall confine myself to that part of the subject which is involved in the feeding of the plant. The broadest principle of rotation is to alternate grain crops with forage crops, grasses with roots, and hoed crops with those sowed broadcast. But there is no fixed rule of rotation. A general one is, to follow plants having a short and rapid growth and which produce seed, by plants of a longer period of growth, which are not allowed to ripen seed, but are harvested for their large amount of foliage.

Plants, like animals, have different ways of feeding. If you were to undertake to keep a dairy of hyenas you would have to provide a different food from that which you give to cows. If you should choose the giraffe as a domestic animal, you would find that its habits of feeding are adapted to very different circumstances from those of your common pastures. The natural food of the giraffe is mainly the buds and twigs of a kind of locust tree that grows in the African wilderness, and the long fore legs and long neck of the animal are shaped for browsing among the tops of those trees. The different classes of plants have peculiarities in their feeding arrangements which are as marked and striking as these differences in animals. This is partly owing to the structure of the roots, and partly to a difference in the leaves. It is

the roots that take up the mineral matters, and there is a great difference in roots. On comparing together the roots of our ordinary crops, we find that when they grow under similar circumstances there is a great difference in the depth to which they extend, a great difference in the degree in which they branch, and a great difference in the absolute quantity of roots. We may divide them, in a general way, into shallow or spreading roots, and deep-growing or tap-roots. The former is well illustrated in the roots of wheat and other grains, as well as the true grasses, while the red clover is an example of a tap-rooted plant. The length and abundance of roots depend upon the character and richness of the soil, the roots keeping near the surface in rich soils, while in sand, roots of Indian corn have been traced ten feet. But whatever changes in these, the peculiarities of their growth remain the same. The growth of roots has not yet been thoroughly studied. Far too little attention has been given, especially in this country, to investigations of roots of plants. Though all the expense we put on tillage of the soil goes into the roots, which alone take up the mineral matters that enter into the composition of the crop, you can go the country through, and not find a man who can give you definite information as to the comparative weight and composition of the roots of our staple crops. It is a very difficult task to follow the entire growth of a root, to trace out all its branches and follow it down in the soil. No man has yet been found to do this completely and systematically; yet what is known of them is most valuable. The development of roots depends greatly upon the soil. If fine and deep, but poor, they go far. In a rich soil they are more compact, and also nearer the surface. Nine tenths of the roots of grain in such a soil are within six inches of the surface. Therefore if we undertake to compare the growth

of roots, we must be careful to do so in similar circumstances. As to depth, Schubart has made the most satisfactory observations we possess on the roots of several important crops growing in the field. He separated them from the soil by the following expedient: an excavation was made in the field to the depth of six feet, and a stream of water was directed against the vertical wall until it was washed away, so that the roots of the plants growing in it were laid bare. The roots thus exposed in a field of rye, in one of beans, and in a bed of garden peas, presented the appearance of a mat or felt of white fibers to a depth of about four feet from the surface of the ground. Roots of winter wheat were observed as deep as seven feet in a light subsoil, forty-seven days after sowing. The depth of the roots of winter wheat, winter rye, and winter coleseed, as well as of clover, was three to four feet. Schubart further collected and weighed the roots of wheat, rye and peas, and ascertained their proportion of the entire plant. Hellriegel has also published some observations on the extent of the roots of barley and oats.

We have a few other observations of this sort, but not enough to enable us to determine the comparative quantity and depth of the roots of our cultivated plants with any accuracy. It will not do to draw conclusions as to the length of roots from such observations as these, made, it would appear, in different soils, differently treated and fertilized, because other observations show that the development of the root depends not exclusively upon any impulse which it receives from the plant, (that is, the root must not necessarily weigh so much or measure so much,) but depends also upon the nature of the soil. Where this is rich the roots tend to remain; they branch and ramify through all the pores of a small bulk of earth. Where this is poor

they stretch off and are sparsely distributed through a larger space. Where they find plenty of food they grow and multiply upon it; where nourishment is lacking they seem to go in search of it. All observations must therefore be comparative. We know, however, in a general way, that the development of roots is different in different classes of plants. We know that clover has a much deeper system of roots than our ordinary grains. We know that where the soil is rich at the surface, and where it is adapted naturally, by its mechanical condition, to the growth of wheat, for example, the large proportion of wheat roots are found within a rather narrow space. On the fertile plains surrounding the town of Leipzig, the principal commercial city of Saxony, situated in one of the richest agricultural regions of Germany, I have seen the same kind of plow going back and forth which you will find pictured in the classical dictionaries as used by the Romans. If you should take a shingle five inches wide and sharpen it to a blunt point, you would have about the shape of the plowshare I refer to.

This wooden instrument, shod with thin iron, did not turn a furrow; it simply made a groove about four inches deep from crest to base, stirring and mixing the soil thoroughly, however, to that extent. This was the only kind of plowing I saw practised on these fields in 1854, and yet splendid crops were harvested from them. The soil was doubtless naturally of excellent texture, and allowed a due penetration of the roots. But the fact remains that with such tillage all fertilizing applications must remain near the surface, and this makes it evident that the roots of our grains need not go down to very great depth. If the soil has nourishment and moisture for them, six or eight inches of earth will answer for the support of a crop. A foot will,

in a majority of cases, where the soil is of good quality, contain the bulk of the roots of the wheat crop. They may go deeper, as Schubart observed, but only because they must descend in order to find food or drink. It has been shown by experiment that roots develop in poor soil in the vicinity of any enriching material; so that we cannot say, because Indian corn roots have been traced for twenty feet in a sand-bank, that it is the habit of the maize plant to send out roots twenty feet long. The length depends upon the soil rather more than upon the plant.

It is greatly to be desired that our knowledge of the relative development of the roots of our various crops should be completed. The roots are in one sense the most important part of the plant. We cannot influence a field crop, except through the roots. We do not manure the tops, or operate upon them in any way. All our efforts to promote growth must be directed to the root, and yet we do not know with precision what is the extent and depth of the roots of the wheat plant, for example, as compared with the roots of any other plant. We simply know that some plants have more and longer roots than others; that clover, for instance, is deeper rooted than wheat.

Some important contributions to our knowledge of this subject have been made quite recently, and I have placed in the table below some figures obtained by chemical analysis of the residues of certain crops: i. e., the stubble, and the roots down to the depth of ten inches. At Proskau, in Prussia, there is a Government Agricultural School, and Dr. Weiske, one of the chemists connected with that school, a year ago last summer, measured off certain plots of land, several yards in dimensions, and carefully excavated the soil to the depth of ten inches, and with extreme pains dug out all the roots he could get in that depth of soil. These

he dried, weighed, and analyzed, and these figures show the average of his results, calculated in pounds upon the surface of an acre. Unfortunately, he did not state anything about the quantity of the crops; but from the fact of their growing at Proskau, where the soil has long been under cultivation, it is presumed that these crops were good.

COMPOSITION OF ROOTS AND STUBBLE—LBS. PER ACRE.

| | Dry Vegetable Matter. | Nitrogen. | Lime. | Magnesia. | Potash. | Soda. | Sulphuric Acid. | Phosphoric Acid. |
|---|---|---|---|---|---|---|---|---|
| Rye | 3400 | 62 | 69 | 14 | 30 | 40 | 12 | 24 |
| Barley | 1515 | 22 | 40 | 5 | 9 | 3 | 5 | 11 |
| Oats | 2200 | 25 | 81 | 12 | 24 | 17 | 8 | 28 |
| Wheat | 2240 | 22 | 72 | 10 | 17 | 11 | 7 | 11 |
| Red Clover | 6580 | 180 | 246 | 46 | 77 | 19 | 24 | 71 |
| Buckwheat | 1630 | 45 | 75 | 7 | 9 | 4 | 6 | 10 |
| Pea | 2400 | 53 | 68 | 11 | 11 | 7 | 9 | 14 |
| Lupine | 2800 | 58 | 76 | 12 | 16 | 3 | 7 | 13 |

The first column gives the amount of vegetable matter which was contained in the roots and stubble. We are not informed what the height of the stubble was; probably it was rather short, as straw is too valuable in most parts of Prussia to be left on the ground. These figures were obtained to throw light on what happens under the circumstances that prevail in the culture at Proskau. We want a similar work done to throw light on what happens under our circumstances, and this work should be repeated several years, so that we shall arrive at average figures that can be fully depended upon. Referring to the table, you have of rye stubble and roots, 3400 lbs.; of barley, 1515 lbs.; of oats, 2200 lbs.; of wheat, 2240 lbs.; of red clover, 6580 lbs.; of buckwheat, 1630 lbs.; of peas, 2400 lbs.; of lupine, 2800 lbs.

You see at once the bearing of these figures.

This table is the work of a careful German experimenter, and it makes some very surprising and important revelations.

Thus you see that the weight of the stubble and roots of clover on a given quantity of land is double that of rye on the same area, and yet going ten inches deep does not take up more than one-half the clover roots while it includes nearly all those of the rye. The proportion is the same in regard to the mineral constituents, and is still greater when clover is compared with other plants in the list. Thus you see the great value of clover as a fertilizer is accounted for in the vigor with which it appropriates food both from the soil and the atmosphere. It brings up, by its deep-growing roots, the mineral wealth of the sub-soil, and leaves it in a place and condition to be easily reached by the roots of succeeding crops. The explanation of many other important problems in agriculture may be found in studying the table attentively, and much help in selecting the best rotations.

You see that when you have got your clover hay off the field, there remains within ten inches of the surface, twice as much vegetable matter as is necessary to go into the next rye crop, and three times as much as is necessary to go into the next wheat crop. That helps to explain why clover is a good preparation for these crops.

A crop of rye or wheat, takes from the soil, in its stalk and seed, *fourteen times* as much of materials as it leaves in the root. While a crop of clover, harvested, takes away only half as much more as it leaves to help make another crop. A crop of clover grown and all ploughed in, will generally furnish nitrogen, potash, &c., for a succeeding crop of wheat, cheaper than by using fertilizers.

Look at the column headed, "Nitrogen." In rye, we have 62; in wheat, 22; in clover, 180 lbs. Take lime. In rye, 69; in clover, 246; and so on. What I want to show mainly by this table is expressed in the first column

of figures—the amount of vegetable matter remaining in the roots.

Here we have another set of figures which refer somewhat in detail to two of our standard crops—rye and clover.

| | Roots. | Top. | Roots. | Ratio of |
|---|---|---|---|---|
| | Av. length. | Weight. | Weight. | Root to top. |
| Rye, before heading........ | 6 inches. | 50 | 30 | 10 : 17 |
| " headed............... | 8 " | 106 | 23 | 10 : 45 |
| " in bloom............. | 8 " | 143 | 24 | 10 : 59 |
| " ripe.................. | 8 " | 253 | 19 | 10 : 136 |
| Clover, before bud......... | 18 " | 56 | 35 | 10 : 16 |
| " in bud............. | 16 " | 94 | 50 | 10 : 19 |
| " in blossom......... | 14½ " | 106 | 45 | 10 : 23 |
| " ripe................ | 15 " | 147 | 99 | 10 : 15 |

In this experiment, due to Heiden, a mass of soil, one foot wide, five feet long, and four feet in depth, was enclosed in boards, then lifted out and the roots removed by careful picking and washing. The average length of the roots was noted, and the total weight of roots and tops ascertained. This was done, as the table shows, at several different periods of growth.

You see from the second column that the roots of rye at the time of heading had an average length of eight inches, and did not gain anything beyond that. In the clover, at the time of budding, their length was eighteen inches ; in bud, sixteen inches. That looks like going back ; but you must remember that the roots measured in the one case were not the same roots as those measured in the other, but were from another plot of ground. In blossom, they were fourteen and one-half inches ; when ripe, fifteen inches. The grand result is simply this : that wherever rye roots were eight inches, clover roots were twice that length ; and this in soils which I suppose were quite similar in character. That is a piece of information of great value.

I have heard old farmers, and young ones too, say that they would give more for that part of the clover crop below ground than for the part above ground. You have here an accurate setting forth of the proportions. Look at the figures which represent the weight of the top and of the roots. You see there is a rapid increase in the amount of top in the rye plant—from fifty up to two hundred and fifty; but you observe that the absolute amount of roots diminishes. Whether that is due to any actual decay of the root, or whether to the fact that each result came from a different plot of ground, or because of different care in extricating the roots from the soil, we have no information. It may be due to the fact that there was less development of root in one place than another.

There was once a German farmer who was supposed to be "clover-mad." He made himself the missionary of clover culture throughout the country, and spent twenty-five years of his life in teaching and demonstrating its value as a fertilizing crop. At first he was laughed at, as most benefactors are, but in the end he received the gratitude of his countrymen. When towards the close of his life the government wished to testify its acknowledgment of the great value of his labors, and offerd him a title of nobility, he chose for his title a name which in English signifies: "The Knight of the Clover Field."

Plants differ also greatly in the action of their roots on the soil. Besides draining soluble matter necessary for their growth from the soil, the roots of plants actually exert a solvent action upon the soil itself. This is a fact which has been recently denied, but it is one that cannot be disposed of by mere denial. The question has been carefully studied

in Germany. Experiments were made at twenty different experimental stations. Equal quantities of a soil made by mixing pulverized sandstone and basalt, first thoroughly washed to extract all soluble matter, were placed in boxes lined with zinc. Seeds of different plants were sown in these boxes, the soil being carefully protected from dust and watered with pure water. One box was left unplanted for the purpose of comparison. The plants grew, and when they had reached their fullest development the circumstances admitted of, they were carefully cleaned, burned and their ashes weighed and analysed. The soil also was analysed in which they had been grown. In every case it was found that there was a great increase of soluble matter which had been made so by the action of the roots upon the soil. It was also found that some plants made twice as much soluble matter as others, and although all the parts were treated alike, with the exception of not sowing seed in the one reserved for comparison, it was found that the boxes containing plants that acted least upon the soil presented double the quantity of soluble matter of the unplanted box. This latter was found, however, to contain some soluble matter; the consequence of the action of the air during the time the experiment lasted. The surface of the soil in all the boxes was kept carefully covered with carded cotton to protect them from all dust. Different plants make different absolute demands on the soil. All must get from it Potash, Lime, Sulphuric acid, Phosphoric acid and Nitrogen; but they take them in different proportions.

The following table exhibits the quantity of different elements taken by different crops from the soil. The quantity of each crop is taken at the average yield from an acre of ground.

TAKEN FROM THE SOIL ON AN ACRE.

| | Weight in lbs. | Total ash in lbs. | Potash in lbs. | Lime in lbs. | Sulphuric acid in lbs. | Phosphor. acid in lbs. | Nitrogen in lbs. |
|---|---|---|---|---|---|---|---|
| WHEAT. | | | | | | | |
| 28 bu. grain....... | 1680 | 34 | 10 | 1 | ½ | 16 | 29 |
| straw...... | 2576 | 114 | 21 | 8 | 3½ | 3 | 16 |
| | | 148 | 31 | 9 | 4 | 19 | 45 |
| CORN. | | | | | | | |
| 37 bu. grain....... | 2250 | 27 | 8 | 1 | 1 | 12 | 36 |
| stalks....... | 4250 | 200 | 70 | 22 | 11 | 16 | 20 |
| | | 227 | 78 | 23 | 12 | 28 | 56 |
| Turnips, (roots,).. | 30240 | 213 | 57 | 28 | 39 | 22 | 60 |
| Potatoes, (tubers,). | 6720 | 55 | 29 | 1 | 10 | 60 | 26 |
| Hay............... | 5600 | 391 | 130 | 35 | 16 | 22 | 56 |
| Clover............. | 6000 | 390 | 105 | 115 | 10 | 33 | 127 |

From this and the previous tables referred to, it will be seen that a crop of clover returns to the soil twice as much mineral matters, such as lime, potash, sulphuric and phosphoric acids, as a crop of rye. Still, as the tables show, rye stands next to clover as a green crop for turning down, and indeed in some soils rye is considered preferable. In Connecticut it is much used to plow in as a fertilizer before tobacco. The lupine, not grown in this country, but much used abroad, is extremely valuable in improving sandy and barren soils. Having now considered the difference existing in plants as regards their roots, it is necessary to a full understanding of the principles underlying the practice of Rotation, that we in turn consider the difference in plants as regards foliage. The leaves of plants are very important organs of nutrition. We know with absolute certainty that a large share of the feeding of the plant is done through the leaves. We cannot certainly tell how much goes on through the leaves and how much through the roots, in highly manured and very rich soil, but experiments have demonstrated that all the carbon of the plant (which is about fifty

per cent. of the weight of the dry plant) may come from the atmosphere; it is not necessary that any of it should come from the soil. The seeds of various agricultural plants—Indian corn, oats, barley, etc.,—have yielded a larger increase under artificial circumstances, where the roots had no carbon whatever at their disposal, than is ever produced under field culture. It is a well-known fact of agricultural practice, that soils which are nearly destitute of vegetable matter, and therefore have no considerable source of carbon in them, will produce large crops. Some very sandy soils, containing but little carbon, may be made to produce heavy crops by irrigation. Crops are also raised on soils free from organic matter, or from sources of carbon, by the aid of fertilizers which themselves furnish nothing of that sort.

Leaves differ much in their characteristics. Some are narrow, and offer but little surface to the air, as in grains and grasses; while others, like clover and the various root crops, have broad and numerous leaves which absorb much from the air. They also differ much in the duration of their leaves. The leaves of small grains and many grasses die early in the summer, while those of the broad leaved plants continue active through the season.

Plants differ greatly in the amount of material they appropriate from the air. The amount so taken is larger than many suppose. As much as ninety-five per cent. of the entire dry weight of some plants is taken from the atmosphere by their leaves. Of 60 pounds of wheat 58 pounds came from the atmosphere through the leaves, and two pounds from the soil through the roots. Plants take up carbon, their principal constituent, from the air in the form of carbonic acid. But although a large proportion of the air con-

sists of nitrogen, and nitrogen is essential to plant growth, they are unable to take it from the air. The nitrogen must be in combination, not pure, as in the air, before plants can assimilate it. When in the form of ammonia, nitric acid, or nitrate of potash and of soda, nitrogen can be taken by the plant. The nitrate of potash and soda (potash and soda saltpeters) are formed in the soils, sometimes very rapidly, (as was explained in the lecture on Exhaustion of Soils.) Some plants, as clover, do not seem to require nitrogenous manures, although, as the table shows, they contain so much. They have the power of taking it from the soil where other plants, like wheat, cannot. Clover will by "nitrification" take 127 pounds of nitrogen to the acre, where wheat takes forty-five pounds. Turnips will help themselves where wheat will starve. As large quantities are left in the soil in the roots of clover, wheat succeeds well after clover.

It has been noticed that corn does not succeed well after turnips. This would be difficult to explain by our ordinary knowledge, but the second table gives us a key to it. It will there be seen that turnips take largely from the soil sulphuric acid and lime, (the ingredients of gypsum or plaster,) and also that the stalk of corn requires much of these same ingredients. Now experiment has shown that corn will do well after turnips if either the turnips or the corn are manured with plaster.

Carbon, then, which makes up half of the weight of the dry plant, is always chiefly supplied by the atmosphere and may be supplied by the atmosphere exclusively. It is not necessary that it should be in the soil. The nitrogen of the plant, which forms indeed a small proportion—two per cent. perhaps, as an average—of the dry plant, is still an important ingredient, for without it vegetation cannot exist.

Some crops have the power of gathering nitrogen without any difficulty; they not only supply themselves with it but they even cause its accumulation in the soil. There are other crops which are dependent upon artificial supplies of nitrogen, unless the soil be naturally very rich in this element —crops which, if we undertake to raise them continuously on the same field, presently begin to show that they lack something, while if we apply nitrogenous compounds as fertilizers, the growth is ensured. We do not know in full detail how plants acquire a sufficient supply of nitrogen from the atmosphere, but we conclude, with great probability, from the results of practice, that different plants draw on the natural supplies of nitrogen in a different way.

Let us consider how the structure and habits of two typical crops, wheat and clover, stand in relation to their power of assimilating atmospheric nourishment. In respect of foliage we cannot certainly say that the wheat plant or the wheat crop, when full grown, exposes a less surface to the air than full grown clover, but we know that the leaves of wheat, as of all of our cereals, maintain their green color and succulence during a much shorter time than is true of clover. In case of winter grain the period of leaf activity usually begins in October and ends shortly after heading out, in June, some weeks before the crop is harvested. Clover, on the other hand, is not arrested in its growth by any crisis of seed-production, but when cut for hay, sends up new shoots, unfolds new leaves, and shortly yields an aftermath, its growth going on uninterruptedly all the summer and late into autumn, until checked by heavy frosts.

That the actual leaf surface of the clover crop, taking its duration into account, is much greater than that of the wheat crop, I do not doubt, because although the total weight of the harvested crops is, on the average, not very unlike when

clover is cut for hay,* the total amount of vegetable matter organized is much greater in case of clover than in that of wheat, as appears from the table on page 389, where clover roots are seen to constitute two-fifths (equal to six-fifteenths) of the entire plant, while the roots of rye, which doubtless do not differ much from those of wheat, are but one fifteenth of the entire plant.

You see that the foliage and mode of life of these two classes of plants are very different for the purposes of gathering food from the atmosphere, and they must therefore be expected to leave the soil in a very different condition, because their roots remain there, and the material of those roots is gathered very largely from the atmosphere; so that when we raise a grain crop we leave in the soil a small quantity of material taken from the air, but when we cultivate a deep-rooted plant which grows the season through, we leave a large amount of atmospheric matter in the soil.

Again, in ordinary culture some plants are permitted and required to reach a crisis of growth which others are not allowed to attain. This crisis is seed-production.

Our meadow grasses are of the same botanical order as the cereal grains; which means that all these plants are of the same great race and closely resemble each other in their most characteristic features. The noble wheat and the scoundrel quack are, in fact, brothers of the same family, both being of the genus Triticum. The latter is sometimes termed wheat-grass, as if in an allusion to this brotherhood. There are two other grasses, vagabond members of the

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* Corresponding crops are, according to

| | *Winter Wheat.* | *Clover.* |
|---|---|---|
| | Lbs. per acre. | Lbs. per acre. |
| E. Wolff | 6,230 | 5,340 |
| Lippe-Weisenfeld | 5,760 | 6,330 |
| Rohde | 4,270 to 6,400 | 3,480 to 5,230 |

wheat family, living obscurely in this country. Barley and the oat have each two brothers of low degree—worthless grasses, living on salt or sandy shores, or on rocky hills, and unknown to the cultivator.

If wheat, instead of being allowed to ripen its seed, as is our universal practice, should be mown or fed off just before heading out, it would throw out new shoots and continue to grow the summer and autumn through ; would come on the second year and deport itself as a perennial; would in fact, become grass in the usual sense of that word. Wheat is probably not hardy enough to make a good substitute for Timothy, but it is sufficiently so to justify our statement.

The reason why wheat under our culture is an annual is that the process of seeding exhausts the plant, and as a consequence it dies out naturally. It is the universal opinion among farmers that the meadow grasses are weakened very much by being allowed to go to seed. I have myself observed that where Timothy seed was raised, the crop of grass the next year was very small, although the soil was excellent. The plants had suffered severely from being allowed to go to seed, notwithstanding Timothy has a bulbous root, which should fortify it considerably against this strain, and a small seed, which renders the exhaustion less than in the case with our bread-grains. The production of seed is thus a critical thing for the life of the plant.

Let us consider again, for a moment, the mode of growth of our cereal grains. Sown in the spring, the plant comes up and grows, slowly at first but with increasing vigor, up to the time of "heading out"—a period of two months. Then the growth acquires its greatest intensity. It heads out, blossoms, and seed begin to form and ripen, and this whole process of seed-production requires but about a month when the weather is favorable for its completion.

In actual trials with the oat plant, it has been found by Bretschneider and Arendt that a large share of the growth of the over-ground part of the plant occurs at the time of heading and blossom. Thus the former observed that out of 6,886 lbs. of the dry acreage yield of the oat, 3,099 lbs., or three-sevenths of the crop, were produced from June 19th to July 8, i. e., in nineteen days; the total period of growth being one hundred and six days. Arendt found that three-eighths of the total dry produce of the oat grew in twelve days, 18th to 30th of June, the period of heading and bloom, and during the twenty-two days between June 18th and July 10th, nearly three-fifths of the growth took place.

Before the seed is ripe the lower leaves begin to turn yellow, and show that their activity is diminishing or has ceased altogether, and the ripening of the plant takes place to great extent, by the removal of matters which have been previously stored up in the stem, leaves and roots, into the seed. You may cut any of the grains at the root when the kernel is in the milk, and the seed will still ripen, and although, if you cut it too early, the kernel will shrink, it will be perfect in its parts and serviceable as seed-grain.

It thus appears that the cereal plant grows from the soil and atmosphere until the seed arrives at a certain stage of development, then the activity of the roots and foliage decreases, the acquisition of food from external sources gradually diminishes, until it ceases altogether, the plant concentrates all its energies upon the seed, all its juices flow thither, and the roots, as well as the leaves and stem, are exhausted in the effort. The seed grows, not directly at the expense of the soil and atmosphere, as the plant has done, but at the expense of the plant itself. It is, indeed, true in all cases that the seed is formed from the plant itself; but there are plants which, while feeding the seed from them-

selves, are still active in gathering food from external sources —and other plants, like the cereals, which do not, at the same time that they are elaborating seed, gather food from outside sufficiently to maintain their individual life.

There is a critical period in the growth of every plant, when it requires an abundant supply of food, and when, if the soil fails to afford it, the crop suffers. In wheat this is at the time the grain is forming. This, after it is fully formed, is ripened at the expense of the nutrient material already existing in the stem and leaves. After the straw turns yellow at the bottom, no more nutriment is received from the roots, and the grain may then be cut. It is the same with other grains, but different with plants like clover. Unlike wheat, it does not open all its flowers and perfect all its seed at once. Its flowers are successive, and it does not die in producing its seed. The top dies, but the root continues to produce leaves. It seems to have, so to speak, a stronger constitution.

Some plants in ripening the seed draw largely on the materials which have been stored in the roots. The root of rye diminishes a third from the heading out to the time of cutting, while the root of clover increases a third in the same period.

In contrast with the cereals, look again at the clover plant. This starts from a seed, grows vigorously, buds, blossoms, forms seed, and the seed ripens; but there is not that uniformity in the time of budding, flowering and ripening of clover that is noticed with wheat. In a field of wheat, if the catch has been good and every thing is as it should be, when one head is ripe all the heads in the field, practically, are ripe. Every stem heads out, blossoms and ripens about the same time. In the case of clover, you have a much greater diversity, especially when the soil is rich and the

plant grows thriftily. If the soil is poor, you will have a nearer approach to uniformity. When you are getting a large amount of foliage, you will find on the same plant ripe heads and buds. If you pick off the ripe heads the plant will still keep throwing out new buds. The process of flowering and ripening is a continuous one, and it does not affect the vigor of the plant to nearly the degree that happens to wheat. During all the period of the growth of the clover plant until the seeds are ripe, the roots are still active and the foliage still vigorous. The quantity of seed produced by the clover plant is much less, relatively to the weight of the plant, than the quantity of seed produced by the wheat plant, and the energies of the clover plant are relatively less occupied in ripening the seed than is the case with wheat.

You would therefore expect these very different plants to have a very different function in the rotation of crops.

An annual plant, again, one that is sown in the spring, or in the fall, perhaps, and is harvested within a year, other things being equal, will be different in its relation to the soil, from a biennial plant, which lives two years, or a perennial plant, which keeps along indefinitely. Now, our ordinary grains are annuals, as we cultivate them; the clover plant is a biennial more nearly than any thing else. When it grows vigorously, it is usually spent, about the second year. We may not call it properly a biennial in a botanical sense, but in an agricultural sense it is a two-year old plant. We cannot depend, ordinarily, upon having much clover from the sowing of 1872, later than 1874, except as the result of self-seeding. Our natural grasses are perennial; they live, we do not definitely know how long. Their mode of propagation, besides from seed, is by root-suckers; the old root dies, but in the meantime it has propagated a numerous family, which succeeds it, and the race is kept up

without the trouble of sowing any seed or giving any attention to the matter at all. These distinctions make an obvious difference in the relation of the three kinds of plants to the subject of rotation of crops.

We have thus considered the plant itself, its roots, foliage, and manner of growth; now let us look more closely at what remains when the crop is removed. When I raise a crop and harvest it, I leave, of course, the roots in the soil; I leave the stubble on the surface. If each crop were taken out of the soil completely, root as well as branch, so that nothing of it were left in the field, the effect of any crop upon the soil would be measured simply by what we took away. But we leave a great deal in the soil. Ever since farming has been practiced, the value of what is left on and in the soil has been, to some extent, appreciated, but we have not known accurately the quantities or the relative proportion of those substances. We have known that clover leaves much more than wheat, but the precise relation we have not understood as we understand it now, and we do not understand it now as we ought to and as we shall understand it after further investigation. I referred yesterday to the table of Dr. Weiske, of Proskau, which gives the ingredients of the stubble and roots of various crops remaining on and in an acre of land after harvest. (See page 387.) This is the first, or nearly the first, exact experiment of the kind that has ever been made, and these observations must be repeated here and there, on different soils, before we can get entirely trustworthy data, to enable us to make a satisfactory calculation. Still, these first results will serve a very good purpose.

In the case of rye, for instance, you have 3400 lbs. of dry vegetable matter remaining in the soil to the acre. Or-

dinary rye straw contains some fourteen per cent. of moisture. The vegetable matter in the table is considered free from that variable amount of water which is always present in the plant, unless it has been dried at the temperature of 212°. In the case of barley, we have about half as much as in rye—1515 lbs.; in oats, 2200 lbs.; in wheat, 2240 lbs.; in red clover, 6580 lbs.; in buckwheat, 1630 lbs., and so on. You see that in the amount of matter remaining in the soil, the clover crop far surpasses any other. If it were a fact that the organic vegetable matter of one crop remaining in the soil supplies the food for the following crop, you see that what remains in the soil from a good clover crop would furnish the material for about three oat or wheat crops. It is not the fact, that the vegetable matter from one crop acts as such directly to support the succeeding crop; but it is a fact that some of the ingredients of the vegetable matter are of use to the succeeding crop, and in some places must be supplied, in order that the succeeding crop may grow. That is especially true of nitrogen. We have in the clover field a residue of 180 lbs. of nitrogen; in rye, we have 62 lbs.; in oats, 25 lbs.; in some other crops we have a larger quantity; you see how the figures run. (P. 387.) This nitrogen came partly from the atmosphere by the foliage, and partly from the soil taken up by the roots. The clover residues contain three times as much nitrogen as those of rye, and 7 to 8 times as much as those of wheat, barley, or oats. We have 246 lbs. of lime remaining in the residue of clover—three times as much as in that of any other crop. This, of course, came from the soil. All these shallow-rooted plants, when they succeed clover, find ready to their hand, in the upper eight or ten inches of the soil, material brought up by the previous clover crop from twice that depth, or more. The clover not only

furnishes to the succeeding crop these mineral matters that were in the upper portion of the soil, but it takes them up from a depth where they would not be directly accessible to other plants, and puts them where they are wanted. The clover plant leaves in the surface soil, as the table shows, a much larger quantity of all those materials than any other crop. The only apparent exception is that of soda, and soda is a substance which is not, as the best information we have upon the subject tends to show, essential to any cultivated plant. We have of magnesia, 46 lbs. in clover, against 14 in rye. Of potash, 77 lbs. in clover, against 30 lbs. in rye. Of sulphuric acid, we have 24 lbs. in the case of clover, against 12 in the case of rye. Of phosphoric acid, which is, on the whole, the most precious mineral substance in the soil, because it is the most costly when we have to supply it by purchase to our fields, we have 71 lbs. in the case of clover, against 24 lbs. in the case of rye.

Now, the point comes in here again to which I referred yesterday, namely, the ratio of root to top and of foliage to seed. In the rye crop, when ripe, I have nearly 14-15ths of the vegetable matter above ground, (and the same is probably true of all the grains,) and when I got off my crop, I got off 14-15ths of the whole. (See table, page 389.) Fourteen fifteenths of the vegetable matter is carried away in my grain and chaff and straw, if I cut close to the ground. In the observations, whose results are given in this table, there was no stubble. If I leave stubble on the ground, I reduce the proportion of removed substances. When I take off the clover plant close to the ground, for every fifteen pounds I take off, I leave ten pounds in the soil; whereas, in the case of rye, for every fourteen pounds I take off, I leave only one in the soil. That is a great difference. When I cut the grain crop low, I take it nearly all

away; but when I mow off my clover hay, I leave two thirds as much as I take. The assertion, which has been made, that the part of the clover crop remaining in the soil is as good as that which goes into the barn, finds its justification in these figures. They show, with precision and in detail, what observing farmers have long vaguely known.

The reason of the truth of the old saying, that if you can start clover, you can grow anything, is thus apparent; and we know further, from observation, that the habits of the clover plant are such that we can often start on a course of improving the soil with that plant when we could not with what are commonly called our more valuable cereal grains. Some years ago I was shown two fields, separated by a fence, one of which you would call perfectly barren and useless; on the other was a growth of red clover about a foot high, which I was told had been brought up within twelve months by the application of a bushel or two of plaster to the acre and turning in some sheep. I believe there was no seed sown upon the field; the plaster alone brought the clover in. The plants were there in an undeveloped state, and I suppose the plaster, by furnishing sulphuric acid and lime, both of which are large ingredients in clover, supplied the two things, or the one thing, it may have been, which was necessary in order to give the clover a chance to live. On the other side of the fence, one or both of these substances was probably not present in sufficient quantity to develop the starveling clover plants and to start their deep roots into the soil; but with that start, there is no reason why that land could not be made agriculturally profitable. It could never be converted into such soil as the Genesee region or a western prairie, because the original constitution or strength was not there; but it was a soil which might, by judicious management, be improved, and brought up to

a reasonable degree of fertility. It would be hopeless to undertake to reclaim any such field as that by the use of wheat grown for seed: it might be done by rye cut green, but it would be a much slower process than by clover. The fields in that neighborhood had been cropped with rye beyond the memory of the oldest inhabitants. The plan had been to take off a crop of rye once in three years, getting about nine bushels to the acre, leaving the soil to itself the other two years. Three years of weathering, and atmospheric action on that soil, put it into a condition to make a rye crop of nine bushels to the acre. If that rye were turned under, instead of being cut off, so as to make the soil more retentive of moisture, it could be brought up; but the clover plant is adapted to do that thing much more rapidly than the rye plant.

We now come to an important question, viz., the possibility of continuing the same crop on a field indefinitely. Should you ask me if that can be done, I could answer both "Yes" and "No," and be equally right in each reply. There are quite a number of agricultural questions that can be answered in just that way. Instances can be brought up in which almost any crop has been grown continuously, without interruption, or with no more interruption than the nature of the plant requires, for a term of years—in many cases for a long period of time. I mentioned yesterday the experience of Mr. Lawes, who has grown wheat twenty-seven years in succession on the same soil, and, without any manure, has got an average of 16 bushels to the acre; while with manure he has averaged 36 bushels to the acre. We know that tobacco can be raised year after year on the same soil, with the help of manure and thorough tillage. The same is true of onions, buckwheat, rye, in fact, I do not know of any crop that may not be grown in that way. And

yet, "circumstances alter cases." Clover will not grow on this or that farm, or on this or that field, with such and such culture, to advantage, unless an interval is allowed between the crops. In some sections, you cannot grow rye without interruption, and anybody can find cases in which none of our crops will succeed, for several years in succession, or even succeed at all. These differences depend chiefly upon the soil, not upon the plant, and it is dangerous to make any sweeping or absolutely general statement where so variable a thing as the soil is concerned.

Clover is a plant which has often given farmers a great deal of trouble to grow year after year, or to cultivate in quick succession. It is generally admitted as a rule of practice that there is, ordinarily, no profit in attempting to grow wheat two years, or, at the furthest, three years in succession on the same soil. It is admitted to be a good plan generally not to grow any crop more than two or three years in succession. Even our natural grasses are included in this rule, although in some particular localities they do well indefinitely. We have indeed natural meadows and pastures which are as old as the memory of man and just as good now, for aught that can be seen, as they ever were. But even in the case of natural pastures we know that "circumstances alter cases." Each farm, perhaps, may have some low-lying piece of moist land occasionally flooded by a river, where grass can be cut year after year. Then we have uplands which must be broken up once in a while; they get "hide-bound," and the grass runs out. These facts are familiar to you all, and illustrate the broad statement that there are some soils where the same crops can be cultivated for a succession of years and other soils on which rotation is quite indispensable. There are soils where clover has been grown once in three years for a very long period. I have

in mind a valley in the Austrian Tryol—the valley of Saint Martin—where this has been done. No one living can remember the time when this practice was not followed on certain parts of that valley. They have a marl which is regularly put upon the land, and by its use the clover crop continues undiminished from generation to generation. Its growth there is also very luxuriant, the ordinary clover stems being five or six feet in height. This is a very remarkable case of natural clover ground kept unexhausted by a native fertilizer. But the land of Mr. Lawes, adjoining the fields where he raised wheat without interruption for twenty-seven years, would not carry clover except at quite long intervals. Mr. Lawes made a series of experiments on this land, beginning in 1848 and going on until 1860, in which he applied stable dung, coleseed cake, super phosphate of lime, sulphates of potash, soda, and magnesia, sulphate and muriate of ammonia, soot, and fresh burned lime, singly and in various combinations. The following is a sketch of the history of the crops obtained from four acres, divided into eighteen plats, during twelve years: 1848; sown to clover and barley, having been heavily manured the previous season and borne a large crop of Swedish turnips. 1849; manured with various applications. Three cuttings yielding at a rate of from three and three-fourths to nearly five tons per acre. Seeded in fall to wheat. 1850; in spring clover-seed was sown on the young wheat. The wheat yield was at rate of twenty-seven to thirty-six bushels per acre. After harvest, the clover catch not being good, the land was plowed. 1851; after manuring again, clover-seed was drilled in, April 28; came up well and was cut in September. Best yield was at rate of one and one-third ton of hay. 1852; clover looked well in winter, but in March symptoms of failure became apparent in many of the plats;

later it died out in patches, more or less, in all the plats, still on the whole a good plant remained, and two cuttings gave hay on best plats at rate of two and one-fourth to three tons per acre. 1853; plants stood fairly through the winter but nearly all died off in spring. Land was then plowed and fresh clover seed drilled in; plants came up weak. There was no crop worth cutting in autumn and during winter nearly the whole died off. 1854; field was plowed and left fallow till September. After heavy manuring (twenty tons yard manure per acre on some portions, and 5,000 pounds quick-lime on others,) clover-seed was drilled in October 10. Plants came up, but died off during winter. 1855; clover-seed drilled in April 14. Best crop was at rate of one-quarter ton of hay per acre. Plants died in winter. 1856 and 1857 land was left fallow. 1858; sown to barley without further manure; crop fifty-eight to sixty-five bushels per acre. 1859; without manuring, sowed to clover. Crop cut in September was one to one and one-half ton hay per acre. 1860; plant looked well through winter, but as spring advanced died off rapidly, and in June the few remaining plants had a stunted and unhealthy appearance.

Thus, after seven sowings and the liberal use of every fertilizing element, Mr. Lawes was compelled to see a complete failure of the attempt to keep his land in clover. He relates that in the rotations customarily practiced in his neighborhood, a good yield of clover can be relied upon once in six or eight years.

The land was what they call "clover-sick." "Clover-sick," and finally clover-dead!

Mr. Lawes made another interesting trial on a piece of originally similar ground, which had, however, been used as a kitchen-garden probably for two or three centuries. It was sown to clover early in 1854, and from this one sowing

the plant grew well, without further manure, for six years, and yielded in that time fourteen cuttings, at the rate of twenty-six tons of hay per acre for the six years, or four and one-third tons yearly.

In discussing the causes of clover sickness, Mr. Lawes suggested that the assumption that clover requires a portion of food to be supplied by the soil in the form of certain organic compounds—vegetable matters or humus, such as are contained in garden earth and come from the yard manure—would perhaps explain why the crop failed on ordinary soil, but should succeed in a garden which had been heavily manured perhaps for centuries. Mr. Lawes did not assert that this was the reason, only that it *might* be.

But I think we have facts enough to justify us in concluding that that is *not* the reason. When a student in Germany, I saw an experiment by Dr. Wolff of the Academy at Hohenheim, which he was in the habit of making for the benefit of his classes. He took a quantity of rather poor soil, and calcined it in a clay muffle—a kind of oven which is heated by fire burning all around it, so that its sides are brought to a bright redness. This operation completely burned out all the organic matter of whatever kind that was originally in the soil. To that soil he added the various components of the ashes of plants which are given in the table page 360, viz.: lime, magnesia, potash, soda, phosphoric acid, etc., in proper proportions, together with a certain quantity of saltpeter—nitrate of potash—and in that soil he raised the most beautiful clover. You can grow anything to perfection in that way. You do not need a particle of organic matter in the soil for the growth of any plant. Many plants have been grown in simple water in which the mineral

elements of the plant, including nitrates, were dissolved or suspended.

The suggestion that the result, in the case to which Mr. Lawes refers, was due to the absence of vegetable matter, must therefore be regarded as destitute of foundation. I believe that if he had spaded his land as deep as the roots of clover go, and had fertilized it well to the same depth, he would have cured the clover-sickness effectually.

The weight of evidence goes to show that this "disease" is owing to the lack of nutritive material in the lower strata of soil, where the long clover-roots go, and where they must find nutriment. Those soils which are naturally adapted to clover are those in which an equivalent to deep manuring is created by the disintegration of the soil itself to a considerable depth.

The soil of the Genesee wheat lands, where their regular practice has been, for seventy or eighty years, to alternate clover and wheat—wheat is their staple crop, and always has been, and they always prepare for it by a crop of clover —is what you would call a rich loam, mixed to a considerable depth with fragments of a slaty rock. This slaty rock decomposes so rapidly as to keep the soil constantly rich, and rich to a considerable depth. It does not decompose on the surface rapidly enough, so that they can get a wheat crop every year, but if they put on clover, and let its roots go down where there are materials which the roots of the wheat plant cannot reach, and bring those up to the surface, then their wheat crop runs right along, and if rust or insects do not interfere with it, they get a large yield every time they try it. They have two years of clover and one of wheat.

There are some further facts in regard to clover which are very interesting. Dr. Voelcker, who has been Chemist

to the Royal Agricultural Society of England for the last twelve years, when he was formerly in the Royal Agricultural College at Cirencester, found that some of the farmers in the vicinity not only thought that clover was an excellent preparation for wheat, but asserted that the wheat did better when, instead of plowing in the second crop, they took it off. The doctor we may suppose was rather incredulous; but he found other farmers who said, "Our wheat does best when we let the clover ripen, and save the seed, and put the wheat in after that." These opinions were put to him in such a way that he could but candidly say, "It would be folly to deny such statements on my knowledge of what is probable; I will look into the matter, and satisfy myself by my own trials. I am living here on the ground, and I can make the experiments, and if it be true, that taking off two crops of clover leaves the soil in better condition for wheat than when one crop is taken off, if I examine the soil when one crop has been taken off and when two crops have been taken off, I ought to find more available nitrogen and more available phosphoric acid in a given quantity of soil in the latter case than in the first case; and if it be true, that where the plant has been allowed to go to seed, the preparation for wheat is still better than in the other two cases, I ought to find still more of those materials." He made the investigation, and actually found that the quantity of those nutritive materials left in the surface-soil after the clover seed had been taken off was greater than when two crops of clover hay had been cut, and greater when two hay crops had been removed than when only one had been taken off. That is due to the fact, which I have already insisted upon, that the clover plant, after producing its seed, is still able, when the character of the soil is adapted to it, to continue its growth and bring up to the surface-

soil those materials which the wheat plant cannot reach. We cannot, from cases of this sort, deduce rules of universal application, and this English experience may not apply to the Genesee valley or to the lands of this vicinity, because of differences of soil, but these results of Dr. Voelcker are of very great importance. They enable us to make the experience of those Cotswold farmers of general value, by showing us the reason of their result. They furnish us a grand contribution to our knowledge of the capacities of the clover plant. If the farmers of Genesee do not find the rule to hold good with them, we shall find, by study, the reason for it.

There is one question I wish to call attention to, and that is the waste of manure, which seems to belong to the production of some crops and not to others. Any man who .for twenty-five years will cultivate a number of plots of land with different crops and different fertilizers, will get hold of a great many facts and find a great many questions coming up which it would be exceedingly interesting to discuss. This is what Mr. Lawes has done. He has shown that on his land, in order to get a large crop of wheat, he must use a great deal of one kind of manure. I mentioned yesterday that he got 16 bushels of wheat to the acre, for twenty-seven years, in unbroken succession, on land to which he applied no manure whatever; that by the use of 14 tons of stable manure per acre, applied annually, he was able to get 36 bushels of wheat. By using all the elements of our fertilizers, with the single exception of nitrogen, applying phosphates, sulphates and nitrates of lime, magnesia, potash, and soda, all the fertilizing matters which are found in ashes, in guano, or in stable dung, nitrogen compounds excepted, he raised the crop to barely 25 bushels; but when, to one good dose of these materials, he added annually 400 lbs. of salts

of ammonia, or nitrate of soda, the yield went up to 36 bushels and held at that point for years. This difference between 25 and 36 was unquestionably due to the nitrogen of the nitrate of soda or salts of ammonia. If the facts admit of any other inference, I do not understand the logic which can make it.

Let us compare the quantities of nitrogen in those two applications. In the salts of ammonia, there were about 80 lbs. of nitrogen; in the barn-yard manure, Mr. Lawes says 200 lbs.; but there are usually nearer 300 lbs. of nitrogen in strong stable manure. It would thus appear that there must be a great loss of nitrogen, and the wheat crop has got the repute, among some writers, of wasting a great deal of nitrogen in its growth.

On another plot of land, where Mr. Lawes raised barley, he applied 200 lbs. of ammonia-salts, which contained 40 lbs. of nitrogen, and raised 48 bushels to the acre. When he doubled his dose, and put on 80 pounds of nitrogen, his grain was so heavy that it lodged and failed to ripen, and the crop was spoiled. Without the addition of any fertilizer, the soil gave him considerably less than half that amount.

I will mention some other experiments which may give us light on this subject, made by Dr. Hellriegel, who has been studying agricultural problems for some twenty years, having been all this time employed in one of the experiment stations kept up in Germany, partly by government and partly by associations of individuals, for the purpose of making agricultural investigations, by the help of chemistry and physiology, and whatever aids can be brought to bear on these questions. Dr. Hellriegel proposed to himself to ascertain what quantities of the different materials which plants require for their growth must be furnished to them in order to get a crop. We have for some years known that phosphate and sulphates

of potash, lime, and magnesia, and nitrogen must be given, but we need to know how much of each of these various substances is necessary. In order to arrive at accurate results, Dr. Hellriegel had to experiment under artificial conditions. So he took for soil a perfectly pure sand, or one as nearly free from everything that would furnish plant-food as possible. In a large series of experiments, he mixed the soil with a sufficient quantity of all the materials necessary for the support of a crop, with in each case one single and different exception. These excepted substances he added in graduated quantities, putting one quantity in one box of soil and a larger in another, and so on through a sub-series of eight or nine boxes, in order to ascertain, by the growth of the plant, in which case he had hit the best proportion of these ingredients. His trials have been extended to the whole list of the elements of the plant. In regard to water, for example, he found that the growth was greatly influenced by the quantity of this substance with which the crop was supplied. There was a certain quantity of water in the soil necessary to a maximum crop, other things being equal. In the sandy soil which he experimented with, the largest yield of rye, wheat, or oats was obtained when the soil held steadily ten or fifteen per cent. of its weight of water. On increasing this proportion, the straw in some cases was heavier, but the grain was reduced in quantity. Thus the very fact that the amount of rain fall is unequal in absolute quantity, and unequal in distribution from year to year, is of itself a reason why you get different crops, everything else remaining perfectly the same. That is a matter always to be taken into consideration in judging of the value or effects of a fertilizer. But it is the effect of nitrogen I am coming at. Dr. Hellriegel experimented with various quantities of nitrogen (in the form of nitrates,) applied also to cereals. The plants grew

in the artificial soil, consisting of pure sand, with an admixture of ash ingredients, in such proportions as previous trials had demonstrated to be appropriate. All the conditions of the experiments were made as nearly alike as possible, except as regards the amount of nitrogen, which in a series of eight trials ranged from nothing to eighty-four parts in a million parts of soil. The following table gives the results:

EFFECTS OF VARIOUS PROPORTIONS OF ASSIMILABLE NITROGEN IN THE SOIL.

| Nitrogen in 1,000,000 pounds of soil. | Yield of grain in pounds. | | |
|---|---|---|---|
| | Wheat. | Rye. | Oats. |
| 0 | 0.0 | 0.2 | 0.3 |
| 7 | 0.5 | 0.8 | 0.9 |
| 14 | 1.7 | 1.9 | 2.6 |
| 21 | 2.7 | 2.6 | 3.8 |
| 28 | 3.7 | 4.2 | 6.2 |
| 42 | 6.1 | 5.1 | 7.0 |
| 56 | 7.2 | 7.1 | 9.0 |
| 84 | 9.2 | 8.7 | 9.3 |

The maximum crops of wheat and rye were obtained with eighty-four parts of nitrogen to one million parts of this soil, but the maximum oat crop was got with fifty-six parts of nitrogen, at least; the gain between fifty-six and eighty-four parts of nitrogen, in the case of oats, was a mere trifle. Dr. Hellriegel made some other observations, which he has not reported in detail, which led him to conclude that he might have got his best crop of wheat with seventy parts of nitrogen, his best crop of rye with sixty-three parts, and his best crop of oats with fifty-six parts, to a million parts of soil. This soil which he used was not a large absorbent or fixer of the substances furnished to the plant. The nitrogen which he used was in the form of nitrates, which are never absorbed by soils, so far as we know. The matters with which he enriched the sand, therefore, were soluble and en-

tirely available to the plant. The latter had only to stretch out its roots to obtain its food, and the quantity of soil was small, so that the roots had not far to travel, and could so completely occupy the soil as to come in contact with all the nourishment it contained.

In reply to the question as to the comparative value of nitrogen in ammonia salts and in animal substances, such as blood, flesh, dung, &c., it is very difficult to say; but these experiments of Mr. Lawes show that in order to get thirty-six bushels of wheat to the acre, he used two hundred pounds of nitrogen, in the form of stable manure, whereas eighty pounds of nitrogen, used in the shape of salts of ammonia, gave the same crop. The reason of that is, that the nitrogen of the salts of ammonia is in a condition to be made immediately available to the plant, whereas the nitrogen in animal manure exists in a form or in forms such that much of it cannot be taken up by the plant at once, if at all. It must undergo an alteration to become of use, and much of it, instead of passing into an available condition, doubtless becomes permanently inert.

As to the circumstances under which the nitrogen of manure is converted into ammonia, which is retained in the soil, and those circumstances in which it is converted into nitrates, which may pass out of the soil: so far as can be judged from our imperfect knowledge, a rapid decay of nitrogenous matter, which goes on with comparative exclusion of air, generates ammonia; on the other hand, where there is a large access of air, there we have nitrates formed. But we do not know minutely the conditions under which nitrates are produced. Another fact to be noticed is this: that in the decay of animal matters with access of air, there is invariably a quantity, and often a large quantity, of nitrogen liberated in the state of free, gaseous nitrogen, such as

exists in the air about us, and which does not assume the form either of ammonia or nitrates, and thus becomes lost as a fertilizer. The indications very strongly favor the general conclusion, that plants accumulate nitrogen in the soil in proportion to the surface of their foliage extended to the air, and to the length of time during which that foliage is in actual growth. The inference would be that there was a proportion between the amount of accumulation and the length of time.

I was about to say how much nitrogen was needed in the soil. A wheat crop of thirty-three bushels, with straw and chaff, contains fifty-six pounds of nitrogen. If we allow for stubble and roots one fifth this quantity, we have for the total nitrogen required in the vegetation of an acre of wheat, say sixty-eight pounds. Hellriegel found, by actual trial, seventy pounds of nitrogen to be sufficient to produce his maximum wheat crop.

Mr. Lawes's soil furnished enough nitrogen to yield seventeen bushels of wheat. Addition of forty-one pounds of nitrogen, in form of ammonia salts, gave twenty-seven bushels, or an increase of ten bushels. Eighty-two pounds of nitrogen applied in the same form gave thirty-seven bushels, or twenty bushels increase.

The reason why Mr. Lawes was obliged to add eighty-two pounds of nitrogen to double the wheat crop, lies in the following considerations:—When ammonia is applied as manure, a portion of it is fixed in a comparatively insoluble condition in a clayey or loamy soil, and a share of this fixed ammonia it is doubtless very difficult for the plant to acquire. Again, nitrification, or the conversion of ammonia into nitrates, goes on, and the nitrates are freely soluble and wash out of the soil. Then we know that the roots of the

plant cannot come into contact with the whole of the soil, so that we should not expect that all the available nitrogen there would be taken up. The figures show that from seventy to eighty pounds is sufficient, provided it is in a form and in a position in which the plant can appropriate it. In stable manure we appear to waste a considerable quantity simply because it is not present in a form in which the plant can use it.

Now, stable manure, when it is put into the soil, may be compared with clover roots or any other vegetable matter put into the soil. Stable manure consists very largely of vegetable matter which has passed through animals, and of more or less litter which we mix with it. There is a small portion of the nitrogen of the manure actually formed into these ammonia salts which Mr. Lawes applied, but most of the nitrogen, in order to be used by the plant, must be transformed, must pass into some other state than that in which it exists in the manure itself; must probably either be converted into ammonia or nitrates.

As to the relative values of the liquid and the solid portions of the manure, no definite answer can be given. It depends somewhat upon the food which the animals have. If they are kept upon low rations the liquids would be the best; but if they are supplied with rich food, grain, meal or oil cake, that indeed increases the value of the liquids, but increases more, relatively, the value of the solids, because you cannot get into the circulation of the animal beyond a certain amount of nutritive matter; but you can run through the intestinal canal much more material which is only partially digested, and so the value of the solid manures, as compared with the liquids, is increased by increasing the richness of the food. When oxen or other herbivorous animals are kept on rations which just maintain them

without much gain or loss of live weight, the daily urine usually contains rather more nitrogen than the dung. Sometimes the nitrogen of the dung exceeds that of the urine, but while all the nitrogen of the urine is adapted for immediate use as plant food, much of that in the dung is comparatively inert. The urine contains also more alkalies than the dung, but the dung usually contains all the phosphoric acid and most of the lime.

Measured by assimilable nitrogen or by alkalies, the liquids are much the best; measured by phosphates, the dung is most valuable. Practically, however, we cannot make a sharp separation. The solids nearly always absorb a good portion of the liquids.

# ROTATION OF CROPS.

A PAPER READ AT THE CRAFTSBURY MEETING OF THE VERMONT BOARD OF AGRICULTURE.

BY W. S. THORPE, ESQ., OF MORRISTOWN.

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MR. CHAIRMAN AND GENTLEMEN:—While only a common farmer myself, I can but feel that I am very incompetent and unable to impart any practical knowledge to others. Yet, could I induce some of our brother farmers to till more acres, and direct their attention to a more perfect cultivation of the soil, I should feel well paid.

God created the world and established fixed laws and principles by which all is governed. He also created man and endowed him with reasoning faculties and intellectual capacity, after which he was placed on earth, to gain his bread as the reward of honest industry.

Man at first was created a farmer, and his rewards have been as numerous as his efforts have been noble. We are told in the Sacred Scriptures that Cain was a tiller of the ground, Abel a keeper of sheep, and that Noah was a husbandman and planted a vineyard. Indeed, no science can boast of greater antiquity than agriculture. History informs us that many years it was almost the only science practised by mankind. We are told that in the primitive times the Chinese, Japanese, and Egyptians held husbandry in the highest estimation. The Romans, too, were great lovers of

field culture, and paid respect to the plow; but how different must have been the system of farming in those days, in comparison with the more improved systems of our time.

When our country was new our fathers did the best they could under the present demands of circumstances, but as our farms are nearly cleared up and stumps nearly gone, I believe that a better course may be followed. Our fathers farmed it principally with the axe and grub hoe, but we, as a class, have advanced some since that time. There are a few yet who are willing to plod on and do their work by the hardest of physical labor. There are others, who form the progressive part of the farming community, that substitute animal strength to perform much of the hard labor on the farm. The mowing machine will cut, with one span of horses and one man, as much grass in a day as five or six men can cut with a scythe. With the sulky horse rake one man can easily rake ten acres in an afternoon. Then there are the hay loader and the horse pitchfork; but of these I will say nothing, as I have used neither of them. We have our reapers, threshers, wood saws, sulky cultivators, horse hoes, steam plows, improved harrows, and many other implements of improvement pertaining to farming, which, if taken advantage of, are of great interest and profit to us; but to have all these things and not use them, or to use them but little, is more hurtful than beneficial, for, probably, no machinery can be kept in repair for less than twelve per cent. With the price of land from fifty to one hundred dollars an acre, we must farm it more extensively and thoroughly, or we shall find that our profits are very small.

The leading agriculturists of Europe at the present time are the English, Scotch, Dutch, and Germans, and we have but to observe in the massive population of those nations, that the support and success of a country depend upon a per-

fect cultivation of its soil. The security of a nation rests upon agriculture. When agriculture receives marked attention, then, and then only, can that nation be powerful in commercial, civil and military affairs. A crowded population in any country calls for the best system of agriculture. The farmer should no longer follow in the paths of by-gone years, when physical strength only was used, attended, too frequently, with small profits.

Truths that were once only hidden mysteries are now revealed, and among the things of to-day is chemistry, to aid the farmer in analyzing his soil, which, if found deficient in elementary substances, can be readily supplied.

During my stay in England last summer I visited many farms, and there found a system of agriculture far in advance of the course generally followed in Vermont;—while speaking of this course I mean the way in which the common farmers conduct their farms. Those who rent their farms pay from fifteen to twenty-five dollars per acre annually, besides taxes and other expenses. There every foot of land that is available is cultivated, and every shovelful of manure is saved, and very great pains taken to collect everything that is perishable and use it in the compost heap, which, with their skill, results in very large and bountiful crops.

The pastures and meadows are unlike ours, for when once seeded down they remain in grass ever after. The grass instead of running out improves from year to year,—with a top dressing occasionally. They usually top dress with phosphate to supply those parts taken from the land, such as bones, blood, hair, horns, wool, &c. The meadow lands are generally dressed with common barn yard manure, which contains the elements that were taken off in the hay crop, of which they usually get from two to three tons per acre. The

rest of the farm is tillage, and farmed on a rotation. In so doing the land is plowed every year, bearing a crop of grain or roots without being seeded to grass. A four year rotation is generally adopted: The first year fallowed till June, then sowed to turnips and roots; the next year barley or oats, seeded with clover; third year, clover; fourth year wheat; and it is surprising to see the amount of produce grown and the amount of stock raised, on a farm of one hundred acres.

The thought occurred to me that perhaps American farmers might adopt a similar plan. Who can say that it is good farming to own one hundred acres of land, and in that one hundred acres have seventy-five acres of pasturing to keep the stock five months in the year, when the remaining twenty-five acres that is under cultivation keeps the stock seven months or the remainder of the year, besides producing grain that is sold and fed to the swine and poultry, and vegetables used by the family.

If a piece of old pasture, when plowed, can be made to produce two tons of hay on one acre, I see no reason why we could not make the seventy-five acres produce the same either in hay, or its equivalent in pasturing, grain or roots. I believe that we can pursue a rotation. Our land is equally as good as theirs, for the soil of England has been cultivated over two thousand years, and the elements that were in it at that time must be greatly diminished, hence such land can only produce its crop in proportion to the amount of fertilizers applied, and these are applied directly to the crop to be grown, that is, the farmer applies those fertilizers containing the constituent parts of the plant which he intends to grow. The soil is like a sponge in holding water and containing the parts which are taken up by the roots of plants, but as our climate is unlike that of England, a like

rotation might not be profitable, but we can adopt one suited to Vermont, or to our particular farms or locations. Our grass land needs plowing once in eight or ten years, and I would suggest that every farmer use a rotation best suited to his own land, or as circumstances may require.

I believe that an eight year rotation might be used with profit generally. This, allowing the farm twenty acres of wood land, would leave eight ten-acre fields. As labor is scarce and high, all wish to manage with as little help as possible. I think on that account grass may be grown with as much profit as anything, so I would apply grass to my rotation if convenient. This course, in going around the eight ten-acre fields in eight years, would allow me to have one ten acre field in corn or roots; second year in wheat, barley, oats, or some other grain crop, seeded to grass; the next two years mowed for hay, and the next four years in pasture. I think this to be about equally divided for the keeping of stock summer and winter, supposing the owner to feed all the crops on his farm. By using a rotation and feeding all our produce on the farm, I believe we can keep two-thirds more stock than the majority of farmers do at the present time, and farms would be all under cultivation. We should have ten acres in hoed crops, ten acres in grain, and at a very low estimate we should get 300 bushels of potatoes, or 1000 bushels of ruta bagas or mangolds per acre, and four or five hundred bushels of grain annually.

After the old mode of farming, we keep our cattle through the winter on hay and straw, without roots, and believe ourselves fortunate if they do not lose flesh; but many of the farmers let cattle lose in the winter all the flesh they gained in the summer, when by feeding them a liberal supply of roots we can grow them as well in the winter as in the summer. It might be a question with some how to get

manure to use on the first ten acres, but I have always noticed that the farmer's manure heap was in proportion to the amount of stock kept. As phosphate is the very best fertilizer for roots that can be used as far as it will go for corn, and fodder-corn if desirable to raise any, a few barrels of phosphate can be bought for the remainder, and, if the season is favorable a good crop may reasonably be expected, and that crop fed out with the other products. The next year there will be plenty of manure.

We labor under some disadvantages in comparison with the English farmer. Our land is rough and in many places unsubdued, remaining very nearly in the wild state of nature —yet we enjoy some advantages over them, inasmuch as our land is comparatively new and rich. Still it is often said that our farms are running out. Sirs, I have often thought to run out our land would be an impossibility. Look at the American forests which have stood for ages; the annual fall of the leaves is continually enriching the ground just as it is with other vegetation, and when the crop taken is returned the soil will produce other plants equally as well, which can be greatly improved by cultivation; but when only part of the vegetable growth is returned, then, and then only, is the soil reduced in its qualities. Nature does not slumber, and when we fail to scatter the seeds of more useful plants over our fields, nature, in her effort to produce, will vegetate a growth of weeds, showing us that if we neglect our duty, nature is continually doing hers.

We should strive to improve the natural quality of our soil. Probably nothing would improve our land so much as under-draining, but as land is cheap, and labor is scarce and high, with no law to compel our neighbor to give us an outlet, we shall have to wait for some time to come before we

can profitably adopt a thorough system of drainage. But we can see that our land is thoroughly plowed. Too much care cannot be taken in this, for if our land is ever so rich, we cannot gain a full profit unless it be sufficiently plowed, pulverized, and prepared in a manner fit to receive the seed, while if so prepared, with care, we are quite sure to reap a good, or at least, a fair crop.

I am aware that some of our pastures are rough and very difficult to till, and I know of only two ways, one of which we must follow: Either to pasture them as long as we can get a little herbage, or let them go back into forests; and I think the latter preferable, as wood is growing scarce in Vermont.

Rotation divides labor more evenly throughout the year. Our crops are more varied. The manure is composed of the constituents of more kinds of feed, and the better the feed the better the manure; and with this mode of farming I believe our farms would greatly improve, as they would all be under cultivation once in eight years. We should not see so many fields covered with brakes, briars, weeds and bushes, a disgrace and an eye-sore to the owner, or at least to any one who has any pride as a farmer; but we should see more and better cattle, sheep and horses, and more and better manure, consequently more grass; and how much more pleasant would it be for our families, and profitable to all, were our farms all smooth, neat, and well managed. They would double and treble in price, because they would double and treble in production. We should hear less of our sons being dissatisfied in staying at home. We should have enough to satisfy the craving desires of any ambitious young man.

There are many things in connection with this which might be spoken of, but I think they will come more properly under some other head. I hope that my brother farmers will give this subject their candid consideration, for the more they look it over, I think, the better they will like it.

# COMMERCIAL FERTILIZERS.

BY

PETER COLLIER, SECRETARY OF THE BOARD.

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## CONSTITUENTS OF PLANT FOOD AND WHENCE OBTAINED.

During the last half century there have been made in this country, England, France, and Germany, careful analyses, amounting in the aggregate to some thousands, of the various grasses, grains, roots and fruits, the development and culture of which is the chief concern of the agriculturist.

These analyses all show that the sources of supply whence the vegetable world derives its food are the atmosphere and the earth, and that though receiving but comparatively a small percentage from the earth, (from 1 to 5 per cent., as a general thing,) this amount is invariable within narrow limits and indispensable. These analyses show further, that, of the 65 elements existing on the earth, plants select for their food but a small number, chief among which are carbon, oxygen, hydrogen, nitrogen, calcium, magnesium, potassium, sodium, iron, sulphur, phosphorus, silicon and chlorine. Occasionally certain other elements are found, but their presence appears to be rather accidental than necessary. Of the list above given, the first four mentioned are obtained directly or indirectly from the atmosphere, the remainder are furnished by the soil.

Moreover these analyses still further show, that while different plants vary widely in the relative amounts of the various elements which they require as food, this difference is in amount rather than in kind, since almost without exception every plant known requires for its growth each of the elements given in the list above; but it is also noteworthy that certain families of plants, allied to each other more or less closely, resemble each other in the food necessary to their growth; i. e., the cereals, as a class, require large amounts of phosphorus and potassium; the grasses and straw large amounts of silicon and potassium; the clovers large amounts of potassium and calcium; the root crops large amounts of potassium.

Numerous experiments have been made with soils artificially prepared, in which there existed no food available to the plant, other than it might derive from pure water and the atmosphere, and in every case it has been found that so soon as the growing plant had exhausted the scanty supply of nutriment stored up in the seed, it has withered and died. Similar experiments have been tried where the plant has been supplied with such food as analyses had shown them to need, and such plants have grown and perfected their seed.

Obviously, from the above experiments, the conclusion is inevitable that plants resemble animals in this, that they demand certain supplies of food for their development, and it is also true that since the various kinds of food adapted to plant life is simpler in its composition, being derived from mineral compounds present in the earth, it has not that wide and almost unlimited choice of food which is presented to animals, whose food, unlike that of the plant, belongs to organic and more complex compounds, many of which, though widely different in physical character, are closely related in chemical composition, and capable, the one or the other alike,

of giving to the animal organization those proximate constituents necessary to its growth and perfection. If now we examine the earth, whence the supplies of plant food are primarily derived, we shall find that those elements taken from it by the plant differ very widely in their comparative abundance, and that while two or three of them make up the greater part of most soils, some others are present in but small quantity, while others still constitute but a very small fraction of a per cent. of the total amount. And yet so small is the absolute amount actually needed by the plant, and with such marvelous success are the roots adapted to search out and assimilate these scanty supplies, that the plant ordinarily thrives well when placed upon virgin soil.

### EXHAUSTION OF SOILS.

But if successive crops are removed from the soil, without any return of these mineral matters which are necessarily carried off in them, there generally, if not invariably, comes a time when a marked decrease in the annual harvest is seen, which decrease continues until it reaches a point at which it steadily remains, with no further perceptible change in either direction. If now we consider the process of formation through which our soils have passed, we shall see that those supplies of mineral food have been derived from the gradual disintegration and decay of the rocks, which are themselves composed of these very mineral constituents, and that this decay and disintegration is constantly going on in the soil, thus adding successive supplies of mineral food. Adding it in this, that though present in the soil before, it was as it were, locked up in chemical compounds and mechanical conditions which rendered it unavailable to the plant. Decay, then, and disintegration results in breaking up these chemical compounds into simple ones, and overcoming these me-

chanical conditions by pulverization so, as it were, to unlock these supplies and furnish them to the plant.

If now the natural changes going on in the soil are sufficient to liberate annually from these insoluble compounds as much of those mineral constituents as the crop removes, it is clear that practically exhaustion could never result. In practice it is found almost invariably, that exhaustion is soon effected of one or another of the necessary constituents, and which one is soonest exhausted depends, first, upon the amount present in the soil and annually liberated, and second, upon the kind of crop grown; since, as we have seen, the demand, made upon the soil for food, differs with the crop, certain crops requiring large amounts relatively of one constituent, and other crops large amounts relatively of some other.

Another point is to be observed, that since the plant derives all its food through the roots, it is capable only of taking up into its circulation and assimilating such food as exists in solution. Mineral food, then, to be available to the plant, must exist either in solution or in a soluble condition. This will account for the prompt action which follows an application of liquid stable manure, and it is often the case that this liquid portion, owing to the presence of a large amount of soluble matters dissolved in it, is far more valuable than the solid portion, which often is comparatively worthless.

### EXHAUSTION NEVER COMPLETE.

It follows, then, that exhaustion is rarely if ever general, but is due to the removal of one or another of those constituents necessary to the growth of the plant; and absurd as would be the practice of that physician who would with a single remedy hope to alleviate all manner of disease,

rheumatism, fever or cholera morbus, so is it to hope that exhaustion of the soil is to be cured by the application of any special fertilizer.

Among the mineral constituents taken up as food by the plant, there are only two which are likely to be exhausted, since they are present, generally, not only in small quantity in the soil, but are taken up relatively in large quantity by the plant. These two are potassium and phosphorus, the former being the characteristic ingredient of potash, the latter of phosphoric acid. Since by no means known to us, is it possible to convert one element into another, the only way by which we can replace in our soils these constituents is by adding to the soil those substances which contain

POTASSIUM AND PHOSPHORUS.

We find the former present in wood ashes, having been taken by the wood from the soil during its growth. This is perhaps the most available source of this valuable fertilizer, although recently there has been found in Stassfurt, Germany, a large deposit of certain minerals rich in potassium, and which probably will soon compete with ashes as a source of potassium, since ashes are becoming scarce, and since also the potassium compound they contain is more valuable for other uses in the arts. These Stassfurt minerals contain potassium in the form of chloride or sulphate, and with the increasing culture of root crops in this country, the potassium necessary to their growth must be supplied more abundantly to our soils than formerly; and these new supplies bid fair to meet at a moderate cost the demand for this element. Phosphorus, the second mineral constituent, is present in even smaller quantities in the soil than is potassium, and is one of the most important of the constituents of plants, especially of the cereals, since nearly one-half the

entire amount of the mineral matter present in the cereal grains consists alone of the compound of phosphorus and oxygen, known as phosphoric acid. The natural sources whence this important element is obtained are bones, guanos, apatite (a mineral resembling very closely in chemical composition burned bones,) and certain phosphatic deposits existing in certain sections, as in South Carolina. All of these substances are used by different manufacturers of superphosphates.

Since in the animal the bony as well as the other tissues are constantly undergoing waste and replacement, we should expect and do find in the liquid excretions evidence of such waste in the presence of large amounts of phosphates, while on the other hand, it is a fact recognized by all farmers that their animals must have certain quantities of food capable of replacing such waste, and in its absence, the use of ground bone for this purpose is, whether advisable or not, quite general. Obviously, then, it is of the first importance to the keeper of stock, that this important supply of this indispensable element in plant food be not allowed to go to waste, as is too generally the practice.

Other mineral fertilizers are applied to the soil, and often with most beneficial results, though often the theory of their action is a matter of conjecture. Of these lime and plaster, or gypsum (a compound of sulphuric acid and lime,) may be mentioned. Although lime is necessary to nearly if not all kinds of plant life, there are few if any of our soils in which it is not present in quantity far beyond the wants of the plant for direct food. But owing to its chemical action, not only upon the earth itself, but also upon those decaying vegetable matters present in the soil, it probably serves to liberate for the plant and make available these

supplies of food present, but which the plant unaided cannot appropriate. It is found to be a valuable addition to the compost heap, hastening disintegration and decay, and bringing the various matters present into a condition adapted to the use of the plant. The same may be said of the action of plaster, which by its solubility in water is carried down into the earth, decomposing those minerals present, and unlocking their stores of plant food, although both the constituents of plaster are invariable components of the ash of plants. But it is found generally that an amount of lime or plaster far greater than is necessary to the plant as direct food may be advantageously put upon the soil.

Of those constituents necessary to the plant which are derived from the atmosphere, it is generally believed, that there is furnished to the plant an abundant supply at all times, with the exception alone of nitrogen.

### NITROGEN.

This important element, although constituting about four fifths of the atmosphere, is nevertheless useless to the plant in this condition, since the plant is able to make use only of those compounds of nitrogen which are at hand, and it is often found that most beneficial results follow the application of some nitrogenous fertilizer. The natural sources whence are obtained these compounds of nitrogen are saltpeter and Chili niter, but these supplies are limited and their prices too high to admit of general use. Another abundant source is in the decomposition of animal or vegetable matters containing nitrogen, as upon decomposition these nitrogenous matters yield ammonia or nitric acid, both rich in nitrogen and capable of assimilation by the plant. By the distillation of bituminous coal, the small amount of nitrogen present goes off as ammonia, and is collected and sold

as sulphate of ammonia. By the decomposition of the animal refuse obtained by expressing the oil from fish, an abundant and cheap supply of nitrogen compounds is furnished, and indeed this is the supply principally relied upon by the manufacturers of manures for furnishing the nitrogen in their products. Guanos also contain often large amounts of nitrogenous compounds.

But it is found that certain plants possess the property of assimilating and storing up in their roots, stalks and leaves large supplies of nitrogen, and thus are enabled to gather and retain this valuable constituent for the use of other plants which may be unable to secure enough for their own growth. Among those plants possessing this property in an eminent degree is clover, whose roots amount in weight to two thirds of the stem and leaves, and a good crop of which will thus leave upon the soil, even after the removal of the clover as hay, from 150 to 200 lbs. of nitrogen to the acre, a supply abundant to meet the wants of any other crop, as of wheat, which is unable to secure nitrogen enough of itself. We see then the important part that clover plays in what is known as "Rotation." Indeed, many farmers think that they can, by means of clover, secure their supplies of nitrogen cheaper than in any other way.

The demand for these three constituents of plant food, potassium, phosphorus, and nitrogen, has created the business of the manufacture and sale of commercial fertilizers. That the return of these to the soil is indispensable to continued fertility may be regarded as settled, since in one way or another this is done in every agricultural section of the world, and it is beyond question that in those countries where the use of fertilizers has been most extensive, there we find the greatest increase in agricultural productions.

IMPORTANCE OF PHOSPHORIC ACID.

The cereal crop of Great Britain annually removes about 92,000 tons of phosphoric acid from her soil, while to replace this, there is an annual sale of superphosphates amounting to 250,000 tons. If now we estimate the average content of phosphoric acid at 12 per cent., and it is doubtless somewhat above that, we have an aggregate of 30,000 tons of phosphoric acid, or about one third of the amount required by the crop. It must also be remembered that England is a great importer of cereals, and that the consumption of these, and the careful preservation of all manures, and their application to the soil, is at least sufficient to make up the two thirds of phosphoric acid which still remain unprovided for. Not only is the loss made up, but in fact the productiveness of English farms has very greatly increased during the past quarter century. In the above calculations no account has been made of those constant additions made available in the soil by disintegration, nor of the large quantities of guano, ground bone, and other fertilizers, rich in phosphoric acid, upon which no estimate can be made.

For the purpose of comparison the following table has been prepared from the latest census returns, from which the immense agricultural importance of this question may be seen.

| | Bushels Cereals. | Weight in tons. | Mineral Matter in tons. | Phosphoric Acid in tons. |
|---|---|---|---|---|
| Great Britain. | 355,000,000 | 10,652,000 | 286,000 | 92,000 |
| United States. | 1,386,000,000 | 35,580,000 | 665,000 | 272,000 |
| Vermont..... | 6,363,000 | 131,000 | 3,000 | 937 |

From the above table it will be seen that our crop of cereals annually removes from our Vermont soil 3,000 tons

of mineral matters, containing 937 tons of phosphoric acid. Were our agriculture carried to as high a level as is that of England, we should return to our grain lands annually about 2,600 tons of superphosphates.

That the judicious use of such fertilizers is to be not only recommended but persistently urged, is manifest from the above considerations. In the above table it will be observed that the ratios between the total number of bushels, the total weight, and the total mineral matter of the cereals of the United States and Great Britain vary greatly. This apparent error is due to the enormous crop of Indian corn raised in the United States, (over 760,000,000 bushels,) the percentage of mineral matter of which is about three-fourths that of other cereals.

### COMMERCIAL FERTILIZERS.

The great demand for fertilizers, for some thing which should restore fertility to exhausted fields, which may bring back once more the bountiful crops of the past century, has caused an extensive business to spring up in their manufacture. But so great has been the ignorance among our farmers as to the fundamental principles of plant growth, that the field has been a fruitful one to the knaves, and the markets have been filled with many so called fertilizers, which, not only worthless themselves, have, while defrauding the farmer of his money, caused him far greater injury in wholly undermining his confidence in scientific agriculture.

Obviously the only thorough remedy is in increased intelligence, but until this is brought about, the only safe method will be for the farmer to purchase only such fertilizers as have an established reputation, and the manufacture of which is under the control of those competent for the work.

Having decided what constituent he wishes to add to his land, the intelligent farmer will secure it at the lowest market price, remembering that a fertilizer may be cheap at $150, or dear at $10 a ton. In several of the states, the manufacturers and dealers are compelled by law to affix to each package of their fertilizer a label showing plainly *the constituents present in the fertilizer and the per centage composition*, and in case the article sold fails to answer this analysis, legal damages may be recovered from the seller. Some such law it is important should exist in our own state, as it would prove, alike to the honest manufacturer and consumer, a protection from the ignorant or unprincipled, who at present suffer only in seeing a steadily decreasing demand for their wares, as their true character becomes known. With such a law enforced the purchaser would have no difficulty in securing what he wished, buying it as intelligently as he would any other product in the market. It is earnestly to be hoped that the time will soon come when our crops will be as judiciously fed as our stock; when the conditions favoring the complete development of wheat, and corn, and clover shall be as well known, and in practice as rigidly observed, as are those relating to the growth of horses, sheep and swine. From generation to generation certain practices have obtained in agriculture, a certain routine has been followed, and success, more or less marked, has resulted, but as regards an accurate knowledge of the fundamental principles involved, it must be confessed that very few of our farmers are advanced much beyond those who cultivated the fertile valleys of the Nile in the days of the Pharaohs. Intelligence, then, is the ultimate hope, and all other means are but temporary and partial.

## MONEY VALUE OF FERTILIZERS.

The market value of fertilizers should be governed by the value of the various constituents they contain. In the case of nearly if not all the commercial fertilizers, their value depends upon the amounts, respectively, of phosphoric acid, potash and ammonia they contain, since in these compounds we have those important elements of plant food, phosphorus, potassium, and nitrogen. But as the plant can only take up those substances which are soluble, it is necessary to take into consideration the condition in which these elements exist. Feldspar contains from 10 to 15 per cent. potash, but owing to its extreme insolubility it is practically worthless as a fertilizer. So, too, the mineral apatite, the phosphates of South Carolina, and other mineral phosphates, though rich in phosphoric acid, are worthless as plant food. If we bury the skeleton of a horse, it may stay in some soils almost unchanged for a hundred years, but treat it with sulphuric acid, and it all becomes soluble, and every atom can be taken up at once by vegetation. The same may be said of horn, leather chips, &c., insoluble compounds rich in nitrogen, but yet of very little if any value if applied directly to the soil. Several eminent agriculturalists and chemists have made estimates of the value of these several ingredients, and in the main there has been pretty close agreement. Prof. Johnson, the Chemist of the Connecticut Board of Agriculture, in the report of that board for the year 1869, page 378, after discussing this question of prices, concludes by adopting the following scale:

| | | |
|---|---|---|
| Soluble phosphoric acid.............. | 16½ c. | per pound. |
| Insoluble phosphoric acid............ | 6 c. | " |
| Nitrogen......... ................. | 30 c. | " |
| Potash........................... | 7 c. | " |

Nitrogen at 30 cents per pound is almost exactly equal to ammonia at 25 cents. That these prices may be relied upon as very near a fair estimate, it may be well to add that they are derived from comparisons of price lists made out by such eminent chemists and agriculturists as Professors Voelcker and Way, of England, Prof. Stoeckhart, of Germany, Hon. S. L. Goodale, Secretary of the Maine Board of Agriculture, and Col. Weld, of New York. It must, however, be borne in mind that under phosphoric acid insoluble in water we may have it in several conditions of insolubility, depending upon the material employed in its manufacture, and that while for the phosphoric acid found in bone dust, the above price, 6 cents, is not too high, the same constituent in powdered apatite would be far less valuable, and, applied upon the soil, practically worthless. For a complete understanding, then, of the value of insoluble phosphoric acid, it is necessary to know the source whence it is derived, whether from mineral phosphates, guanos, or bones.

## SUPERPHOSPHATES.

But within the past few years a new and important question has arisen concerning the valuation of phosphoric acid in commercial fertilizers, which, in justice to the numerous manufacturers and purchasers of these products, should be taken into consideration. In order to approach the discussion of this matter intelligently, it is necessary to understand the general principles in the manufacture of "*superphosphates*." This is a scientific term, implying originally a certain class of salts of phosphoric acid soluble in water in distinction from such as were insoluble; but which term has come to be applied technically to commercial fertilizers containing phosphoic acid, more or less of which exists in this condition of superphosphate, i. e., soluble in water. Common phosphoric

acid is what is known in chemistry as a tri-basic acid, i. e., capable of uniting with three parts or molecules of a basic substance, as lime. But instead of lime, water may be substituted, and, if for two parts of lime, two parts of water are substituted, we have a superphosphate. In bones, the phosphoric acid is united wholly to lime, and in this form is insoluble in water, but by treating bones with sulphuric acid (oil of vitriol) the sulphuric acid will remove from the bones two-thirds of the lime and substitute in its place water, and in this form the bones are converted into a soluble condition. With this lime removed from combination with the phosphoric acid, the sulphuric acid unites and forms sulphate of lime, or, as it is commonly known, plaster or gypsum, so that this must be a constituent of all genuine superphosphates. Of course, if sulphuric acid is not used in sufficient quantity, an amount more or less great of the tri-basic phosphate of lime, as it exists in bones or mineral phosphates, will remain undecomposed, and therefore insoluble. This is found to be the case in many superphosphates present in the market, and indeed owing to the very injurious effects which would follow from an *excess* of sulphuric acid, above that needed to render the phosphoric acid soluble, it is generally thought best not to attempt the liberation of the whole of the phosphoric acid. We have then as regular constituents of a commercial superphosphate, 1st, soluble phosphoric acid, existing as monocalcic phosphate, i. e., having as two-thirds of its base water and one-third lime, and in this form freely dissolving in water; 2d, sulphate of lime (plaster) from the union of sulphuric acid and lime; 3d, insoluble phosphoric acid in greater or less amount, according to the absence of sufficient sulphuric acid to decompose it.

## RETURNED OR REVERTED PHOSPHORIC ACID.

But it is found that when the raw materials used in the manufacture contain appreciable amounts of iron or alumina, as is the case in most of the mineral phosphates upon which manufacturers must depend for their supplies, the soluble phosphate present undergoes a change, more or less rapid, by which it becomes no longer soluble as before. The chemical principles involved in this change are imperfectly known, but it results in the formation of insoluble phosphates of iron and alumina, with the *reversion* of the soluble lime phosphates to an insoluble condition. These insoluble phosphates, formed from constituents previously existing in a soluble form, are termed "*Reverted or Returned Phosphates*," and the phosphoric acid present in them is estimated as reverted or returned phosphoric acid.

Now although "returned" to the insoluble state as these are, it must not be confounded with that state of far greater insolubility, in which they previously existed in the raw material before manufacture, for it is found that though insoluble in pure water, they are still readily soluble in water holding in solution various salts or carbonic acid, and inasmuch as these conditions are present to a greater or less extent in the soil, the so called returned phosphates may still be available as plant food. The question then resolves itself into one concerning their relative availability as food, compared with that form of phosphoric acid known as soluble, and here there is considerable discrepancy, though in the main all chemists, agriculturists and manufacturers, agree that their value is far in excess of those more insoluble forms already spoken of.

## RELATIVE VALUE OF RETURNED PHOSPHORIC ACID.

It might be supposed, inasmuch as a soluble phosphate, after having been spread upon the soil and dissolved by rains, is speedily converted into an insoluble (i. e. a reverted) condition through the agency of those minerals found in all soils with which its solution soon comes in contact, that no further discussion was necessary, but that we might accept the conclusions of the Chemist of the Agricultural Department of Washington, Mr. Ryland T. Brown, (Dept. of Agriculture, Report 1871, p. 95,) in which he estimates this soluble and reverted phosphoric acid together, and places the same value upon each. But it must be borne in mind that whatever favors distribution of plant food in the soil will tend to the distribution of roots, and thus present to the plant a more abundant supply whence to derive its nourishment, and it seems that this change of phosphates in the soil from the soluble to the reverted condition, from the manner in which it takes place, can but result in a much wider distribution. In an elaborate paper read before the Chemical Section of the Glasgow Philosophical Society, by T. D. Patterson, F. C. S., upon "The Part which Ferric and Aluminic Oxides play in the Manufacture of Superphosphates," the author concludes that so much of the phosphoric acid as has united to form iron or alumina phosphates in the reverted phosphates, is practically worthless, but that the entire amount of reverted is not of this character, but so much of it as exists as iron or alumina phosphates. This matter was recently under consideration before a convention of German manufacturers and agriculturists, held last year at Coblenz on the Rhine, and the conclusions there arrived at have been adopted in this report in the fixing of prices. For definite information concerning this matter, I am indebted to

Prof. G. C. Caldwell, of Cornell University, from whose letter I quote:

"It was generally agreed that the 'returned' phosphoric acid was worth considerably more than what had never been made soluble at all, although the manufacturers contended that it would make too much trouble to distinguish the one from the other in making up their statements in regard to the composition of their products. It was finally decided that in their statements the manufacturers should guarantee a certain per cent. of *liberated* phosphoric acid (I can think of no better word for their term *aufgeschlossener*,) and at the same time that *two-thirds* of this liberated acid shall be soluble in water. If on chemical examination of any superphosphate, it shall be found to contain less than the guaranteed amount of *liberated* acid, for every per cent. (or pound in a hundred) so found wanting, the dealer shall refund 4½ silver groschen (11¼c.,) and for every per cent. (or pound in a hundred) of soluble acid which is wanting, he shall refund 1½ silver groschen in addition (3¾c). At this same meeting 2 silver groschen (5c.) per pound was allowed for the *unliberated* phosphoric acid."

From the above it will be seen that the several prices placed upon soluble, returned and insoluble phosphoric acid respectively, were 2, 6½ and 8 silver groschen, or in gold very nearly 5, 16 and 19½ cents. If now we adopt the value for soluble phosphoric acid given on page 433, the relative value of returned will be 13 1-5c, and we shall have the following scale of figures which are used in the estimation of the various fertilizers the analyses of which accompany this article.

| | | | | |
|---|---|---|---|---|
| Soluble phosphoric acid | | | 16¼ c. | per pound. |
| Returned | " | " | 13⅕ c. | " |
| Insoluble | " | " | 6 c. | " |

It will be seen that the relative value of insoluble is much greater in the above list than in that of the German prices, and very much greater also than its real value, if it be derived from a mineral phosphate, since, as has been already seen, it is practically worthless. In these estimates it does not follow, of course, that these several materials, which give value to a fertilizer, cost these prices to the manufacturers. They may be obtained often from various crude substances at much cheaper rates. But if the phosphoric acid, the ammonia, the potash were bought in the market in the most available forms, they would cost *no more* than above estimated, and no farmer would desire to pay *more* than the aggregate value of these market rates. These materials moreover constitute all that gives value to the fertilizer, the rest being organic matters, water, sand, coal dust, and plaster, the latter indeed being worth some thing, though purchasable in any quantity from $8 to $10 a ton. It is also to be remembered that neither of these valuable constituents, in the condition in which they are present in the fertilizers, emit any odor whatever, although an idea seems to prevail among many farmers that a fertilizer is not worth much unless it smells bad. This offensive smell, which is given off by many fertilizers, good and bad alike, is of itself exceedingly undesirable, and of no value whatever as evidence in deciding between different fertilizers, since it arises from putrefaction and decay of the various animal matters present in the mass, and which are added for the nitrogen they generally contain, though often in very small quantity. It is obvious that no prudent farmer will consent to sell from his farm any refuse matter as stable manure, ashes, bones, dead animals, &c., at less than market value, any more than he would any other farm product, since each of these contain large quantities of one or another

of these valuable fertilizing constituents. Any one so doing would be no less culpable than he who sold wheat at a dollar a bushel, when it was worth $1,50 in the market, and yet there are many who count as clear gain, any sum obtained for ashes, bones, &c., and who sell ashes at one-third their value without causing much surprise at their folly.

### INCREASING DEMAND FOR SUPERPHOSPHATES.

We have already alluded to the enormous sales of superphosphates in Great Britain, amounting to 250,000 tons annually. In the United States their introduction was later, and their use has been confined therefore chiefly to New England and the States of the Atlantic seaboard, but even here the annual consumption is estimated to reach at least 100,000 tons, and is rapidly increasing. That this rapid growth is justified by experience in their use there can be no doubt, and the case is placed so clearly in a lecture given upon the subject, by Hon. S. L. Goodale, Secretary of the Maine Board of Agriculture, that I cannot forbear quoting his words:—

"Now consider that the trade in commercial manures has grown to its present magnitude under the patronage of farmers alone—that these large amounts are bought and used and paid for by a class of men who are habitually cautious about introducing new ways into their practice, averse to parting with money except for "value received," and are as capable as any other class of judging whether they get money's worth for money. I do not say that a farmer may not be cheated as easily as another man,—for once,—but to believe that farmers, as a class, for a series of years will continue to pay out money in sums larger and larger every year, for what does not give satisfaction, I can no more

believe, than that five and five are equal to forty. Do not the facts rather prove, that so much as has been skilfully and honestly manufactured, must have been very good, and very profitable at the price it bore? How else, by any possibility, could the trade be sustained, and exhibit a steady growth under the accumulated odium of all the frauds connected with it?

"Fraud is not the only reason why commercial manures sometimes fail to produce the results anticipated. Ignorance has something to do with it. I have been witness to a degree of ignorance on the part of a manufacturer who advertises and puffs his wares loudly and persistently, which, if it had only been related to me I should have been slow to believe, except upon testimony impossible to discredit. And there is more or less, not very unfrequently, of mismanagement in their application and use."

### HOME MADE SUPERPHOSPHATES.

A word in reference to the manufacture of home made superphosphates. From time to time agricultural papers lay before their readers recipes for the making of superphosphates and advising them so to do, and not a few are disposed to follow the advice. As to the methods pursued in their manufacture there cannot be any secret, for the principles involved are few in number and may be learned by any one. Any respectable manufacturer, I presume, will freely throw open his works to public or private inspection. The great difficulty in the way is a want of knowledge of those chemical principles upon which, though few in number, success depends. The best raw materials differ widely in their composition, and it is only by the faithful labors of a competent chemist that, from such varying material, a uniformly valuble product may be obtained. Honesty alone in the manu-

facture will avail little. It must be allied with intelligence. Again, the chemicals employed are such, that without great care unfortunate accidents may result, and furthermore the cost, at which in small quantity they could be procured, would be 100, 200, 300, or 400 per cent. greater than the extensive manufacturer has to pay for the same. In a lecture delivered by Dr. Voelcker in England, he says: "I do not recommend the system of home made superphosphates. For some time we made our own at the agricultural college farm at Cirencester; but taking the quantity of soluble phosphate produced, we found we could not make it so cheap as it could be bought. There is a decided advantage in buying a superphosphate." And in the same lecture he says: "I lay particular stress on the term *intelligent manufacturer*, because I believe it to be a *hazardous undertaking* for the farmer to prepare his own superphosphate, considerable knowledge being required together with practical acquaintance with the method and proper appliances." Mr. Goodale, above quoted, after detailing the numerous difficulties in the way, insurmountable to the ordinary farmer, strongly advises the farmer to purchase rather than to attempt the manufacture, and concludes by saying: "That though the farmers are sometimes induced to try the experiment (of manufacture) for once, it is very rare for any to repeat it a second time. One dose of this sort of experience (as far as my observation has extended) suffices for a cure in nineteen cases out of twenty."

## FRAUDS IN FERTILIZERS.

It must be apparent at a glance that there is, in the manufacture and sale of these fertilizers, room for most gigantic fraud, and indeed evidence is not wanting to show that in every country, not even excepting our own, men have been

found unprincipled enough to avail themselves of these advantages. Chemical analysis alone can suffice to determine the composition and value of a fertilizer, and this involves considerable expense. Shortly after the introduction of commercial fertilizers in England, the most excessive frauds were practiced upon the farming community, and even so late as 1855, Prof. Voelcker declared "that if ever there was a time when the agriculturist had need to exercise special caution in the purchase of artificial manures, that time is the present, for the practice of adulterating standard fertilizers such as guanos, superphosphates, &c., has reached an alarming extent." At the present time, however, these manufactures have for the greater part passed into the hands of intelligent capitalists, who are content with fair and legitimate profits, and for the interest of whom it is to maintain a respectable standard for their products. We are however passing through this early stage of English experience, much more rapidly it is to be hoped, however; but to day in many of our markets, even in Vermont, may be found *so-called fertilizers*, barely worth the barrels in which the stuff is packed, and the sale of which in the present state of our knowledge of agricultural chemistry, is certainly a reproach, and should be made a criminal offence.

If this seems too strong condemnation to any, they need but examine a pamphlet issued in the interests of the "*Grafton Mineral Fertilizer!*" "it being," as the pamphlet declares, "the pulverized ore from the vein of the Grafton Gold Mine." Upon the cover of the pamphlet, together with the analysis, is propounded in large capitals the agricultural conundrum "*What is It?*" a gentle reminder of our American showman, sufficient, one would think, to place the unwary farmer upon his guard.

Numerous testimonials are given to show this fertilizer to be valuable "for cleaning knives and other things;" for vines, &c., though "much better effects are observed from its application where mixed with the 'suds' from the weekly washing;" "for destroying insects and vermin;" also "an excellent article for cleaning glass and paint;" "sure death to striped bugs;" "an excellent substitute for Bristol Brick," &c. The vendors of this mineral fertilizer also vouchsafe the following explanation (?) of its effects "as a *destroyer of insects*," which "is probably to be found in its *carbonic acid*, the effect of the *rapid liberation* of which from the ore in its *powdered state* can readily be imagined"!!! Also that "it requires considerable moisture (!) to dissolve the Grafton fertilizer and render it food for the growing crop," from which latter statement I venture to say, no one familiar with the solubility of quartz, dolomite, iron and copper pyrites, galena and zinc blende, will dissent. A pound of the fertilizer indeed would require about as much "*moisture*" as would have washed clean the bloody hands of Macbeth.

A worthy rival for public favor has sprung up in the "Stevens Fertilizer," also "mineral," and for the discovery of this exhaustless store, we are indebted to "a German chemist," name not given,—was it Liebig? Testimonials in abundance prove its equal value to the Grafton, but in addition "it is a success as a disinfectant and deodorizer," and "mixed with wood ashes in the leach, it makes the best soft soap," while "for neutralizing the poison of the ivy," its "solution in boiling water" or its application "as a poultice effected a perfect cure in three hours."

But there is no need to extend the list of these, for their name is legion. Analyses of these accompany this article.

## PREVENTION OF FRAUD.

What then can be suggested to protect the public from these and similar frauds? First, and foremost, is intelligence concerning the general principles of vegetable growth. Secondly, legislation. In Great Britain the usual method is to purchase upon a guaranteed analysis, and if the article bought fails to contain the guaranteed amounts of the several constituents, damages may be recovered by the purchaser.

In several of our own States, laws have been passed compelling every manufacturer to affix a label stating the percentage composition of the several valuable constituents, with provisions for recovering in case of any deficiency, and such a law it is desirable should be placed upon our statute book. Still another is, to buy only the product of *reputable* and *intelligent* manufacturers; for a glance at the analyses of fertilizers, submitted with this paper, will show that often the errors arising from ignorance or carelessness in manufacture are as disastrous to the buyer as though resulting from deliberate fraud.

## WHAT CONSTITUTES A GOOD FERTILIZER.

In conclusion, then, a good commercial fertilizer should contain at least some one of the constituents of plant food already enumerated, viz., *phosphoric acid*, *nitrogen*, *or potash*, and these should be in a condition such as to enable them *readily to pass into solution*, and thus available as food to the plant. Besides it is most desirable that a certain brand be *uniform and permanent in composition*, so that the farmer may be enabled to duplicate his results from year to year. Lastly, it is important above all things else, that an analysis accompany each package offered for sale, and that

its composition be guaranteed in order that the buyer may know what he is buying, and may be enabled to select that particular constituent which he wishes to apply to his crops.

In the following analyses, which have been made throughout in duplicate, the returned phosphoric acid was estimated by first removing the *soluble* by washing in pure water and estimating it, and then dissolving the *returned* by digestion in a solution of ammonium citrate. The *insoluble* was estimated in the residue left after removal of the soluble and returned. The total having been estimated in a separate acid solution, the returned was found by subtracting the sum of the soluble and insoluble.

In certain of the superphosphates a small amount also of potash was present, of which account will be made subsequently. The sulphate of lime present in each, when not added as an adulteration, is equal approximately to three times the percentage of soluble phosphoric acid, and may be estimated in this precipitated condition at $10 per ton, and added to the values given to each fertilizer. In the analyses given, the nitrogen present in any sample is calculated, for convenience of comparison, as ammonia ($N H_3$) though in certain samples it may be present in the form of nitric acid.

The phosphoric acid present, whether soluble, returned, or insoluble, is estimated as phosphoric anhydride ($P_2 O_5$).

The prices given upon pp. 438 and 443 are adopted in the estimation of values, viz:

Soluble phosphoric acid.................16¼ c. per pound.
Returned " " .................13½ c. "
Insoluble " " .. ............... 6 c. "
Ammonia..............................25 c. "
Potash................................ 7 c. "

The analyses herewith given include, so far as I can learn, all the commercial fertilizers sold in Vermont. They have been obtained generally from the agents selling them, but in some cases from the manufacturers themselves. The sources whence the samples for analyses were obtained is given in each case, and it is believed that from the care taken in selecting them that a fair average has been obtained of each lot analysed.

NO. 1.

Name: FALES' CONCENTRATED FERTILIZER.

*Received from George W. Beckwith, Burlington.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid.................. | .64 | per cent. |
| Returned " " ................. | 1.15 | " |
| Insoluble " " ................. | 5.39 | " |
| Ammonia.............................. | 2.58 | " |
| Plaster, Sand, Water, Organic Matter, &c.. | 90.24 | " |
| | 100.00 | |

*Value per ton of* 2000 *pounds.*

| | | |
|---|---|---|
| 12.8 | pounds Soluble Phosphoric Acid............. | $2.08 |
| 23.0 | " Returned " " ............. | 3.04 |
| 107.8 | " Insoluble " " ............. | 6.47 |
| 51.6 | " Ammonia......................... | 12.90 |
| | | $24.49 |

NO. 2.

Name: MILES & CO.'S SUPERPHOSPHATE.

*Received from Ross & Co., Northfield, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid.................. | 8.59 | per cent. |
| Returned " " ................. | .00 | " |
| Insoluble " " ................. | .41 | " |
| Ammonia.............................. | 2.88 | " |
| Plaster, Sand, Water, Organic Matter, &c.. | 88.12 | " |
| | 100.00 | |

*Value per ton of* 2.000 *pounds.*

| | | |
|---|---|---|
| 171.8 | pounds Soluble Phosphoric Acid............ | $27.92 |
| . | " Returned " " ............ | .00 |
| 8.2 | " Insoluble " " ............ | .49 |
| 57.6 | " Ammonia........................ | 14.40 |
| | | $42.81 |

NO. 3.

Name: BRADLEY'S X. L. SUPERPHOSPHATE.

*Received from the Manufacturer, Boston, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 5.95 | per cent. |
| Returned " " | .55 | " |
| Insoluble " " | 5.30 | " |
| Ammonia | 2.96 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 85.24 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 119.0 | pounds Soluble Phosphoric Acid | $19.34 |
| 11.0 | " Returned " " | 1.45 |
| 106.0 | " Insoluble " " | 6.36 |
| 59.2 | " Ammonia | 14.80 |
| | | $41.95 |

No. 4.

Name: BRADLEY'S B. D. SEA FOWL.

*Received from Manufacturer, Boston, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 4.85 | per cent. |
| Returned " " | 1.05 | " |
| Insoluble " " | 6.81 | " |
| Ammonia | 2.93 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 84.36 | " |
| | 100.00 | " |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 97.0 | pounds Soluble Phosphoric Acid | $15.76 |
| 21.0 | " Returned " " | 2.77 |
| 136.2 | " Insoluble " " | 8.17 |
| 58.6 | " Ammonia " " | 14.65 |
| | | $41.35 |

NO. 5.

Name: BRADLEY'S B. D. SEA FOWL.

*Received from J. L. Fletcher, St. Johnsbury.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 5.29 | per cent. |
| Returned " " | 2.84 | " |
| Insoluble " " | 7.61 | " |
| Ammonia | 2.13 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 82.13 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | | |
|---|---|---|---|
| 105.8 | pounds | Soluble Phosphoric Acid | $17.19 |
| 56.8 | " | Returned " " | 7.50 |
| 152.2 | " | Insoluble " " | 9.13 |
| 42.6 | " | Ammonia | 10.65 |
| | | | $44.47 |

NO. 6.

Name: BRADLEY'S PATENT SUPERPHOSPHATE.

*Received from Manufacturer, Boston, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 4.53 | per cent. |
| Returned " " | 2.63 | " |
| Insoluble " " | 7.29 | " |
| Ammonia | 3.25 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 82.30 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | | |
|---|---|---|---|
| 90.6 | pounds | Soluble Phosphoric Acid | $14.72 |
| 52.6 | " | Returned " " | 6.94 |
| 145.8 | " | Insoluble " " | 8.75 |
| 65.0 | " | Ammonia | 16.25 |
| | | | $46.66 |

## NO. 7.

Name: BRADLEY'S PATENT SUPERPHOSPHATE.

*Received from L. Pease & Son, Hartford, Vt.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 1.49 | per cent. |
| Returned " " | 4.50 | " |
| Insoluble " " | 6.89 | " |
| Ammonia | 2.17 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 84.95 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 29.8 | pounds Soluble Phosphoric Acid | $4.84 |
| 90.0 | " Returned " " | 11.88 |
| 137.8 | " Insoluble " " | 8.27 |
| 43.4 | " Ammonia | 10 85 |
| | | $35.84 |

## NO. 8.

Name: BRADLEY'S PATENT SUPERPHOSPHATE.

*Received from J. L. Fletcher, St. Johnsbury.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 6.44 | per cent. |
| Returned " " | 2.75 | " |
| Insoluble " " | 3.40 | " |
| Ammonia | 3.01 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 84.40 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 128.8 | pounds Soluble Phosphoric Acid | $20.93 |
| 55.0 | " Returned " " | 7.26 |
| 68.0 | " Insoluble " " | 4.08 |
| 60.2 | " Ammonia | 15.05 |
| | | $47.32 |

NO 9.

Name: ENOCH COE'S XX SUPERPHOSPHATE.

*Received from A. B. Ashley, Burlington.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 9.76 | per cent. |
| Returned " " | 1.37 | " |
| Insoluble " " | 1.10 | " |
| Ammonia " " | 2.89 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 84.88 | " |
| | 100.00 | |

*Value per ton of* 2000 *pounds.*

| | | |
|---|---|---|
| 195.2 pounds | Soluble Phosphoric Acid | $31.72 |
| 27.4 " | Returned " " | 3.62 |
| 22.0 " | Insoluble " " | 1.32 |
| 57.8 " | Ammonia | 14.45 |
| | | $51.11 |

NO. 10.

Name: E. FRANK COE'S SUPERPHOSPHATE.

*Received from S. A. Brownell, Essex Junction.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 7.85 | per cent. |
| Returned " " | 5.76 | " |
| Insoluble " " | 4.60 | " |
| Ammonia " " | 3.05 | " |
| Plaster, Sand, Water, Organic Matter, &c., | 78.74 | " |
| | 100.00 | |

*Value per ton of* 2000 *pounds.*

| | | |
|---|---|---|
| 157.0 pounds | Soluble Phosphoric Acid | $25.51 |
| 115.2 " | Returned " " | 15.21 |
| 92.0 " | Insoluble " " | 5.52 |
| 61.0 " | Ammonia | 15.25 |
| | | $61.49 |

NO. 11.

Name: RUSSELL COE'S SUPERPHOSPHATE.

*Received from Albert Chapman, Middlebury.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 6.19 | per cent. |
| Returned " " | 6.28 | " |
| Insoluble " " | 2.75 | " |
| Ammonia " " | 1.36 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 83.42 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 123.8 | pounds Soluble Phosphoric Acid | $20.11 |
| 125.6 | " Returned " " | 16.58 |
| 55.0 | " Insoluble " " | 3.30 |
| 27.2 | " Ammonia | 6.80 |
| | | $46.79 |

NO. 12.

Name: CANADA SUPERPHOSPHATE.

*Received from C. G. Pringle, Charlotte.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 7.23 | per cent. |
| Returned " " | .22 | " |
| Insoluble " " | 3.07 | " |
| Ammonia | 1.93 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 87.55 | " |
| | 100.00 | " |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 144.6 | pounds Soluble Phosphoric Acid | $23.50 |
| 4.4 | " Returned " " | .58 |
| 61.4 | " Insoluble " " | 3.68 |
| 38.6 | " Ammonia | 9.65 |
| | | $37.41 |

NO. 13.

Name: CANADA SUPERPHOSPHATE.

*Received from Ezra Horsford, Charlotte.*

| | | | |
|---|---|---|---|
| Soluble Phosphoric Acid | | 12.96 | per cent. |
| Returned " " | | 1.46 | " |
| Insoluble " " | | 6.56 | " |
| Ammonia | | 2.17 | " |
| Plaster, Sand, Water, Organic Matter, &c. | | 76.85 | " |
| | | 100.00 | |

*Value per ton of 2000 pounds.*

| | | | |
|---|---|---|---|
| 259.2 | pounds | Soluble Phosphoric Acid | $42.12 |
| 29.2 | " | Returned " " | 3.85 |
| 131.2 | " | Insoluble " " | 7.87 |
| 43.4 | " | Ammonia | 10.85 |
| | | | $64.69 |

NO. 14.

Name: GREEN MOUNTAIN SOLUBLE PHOSPHATE.

*Received from Geo. W. Beckwith, Burlington.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 19.46 | per cent. |
| Returned " " | .00 | " |
| Insoluble " " | 8.43 | " |
| Ammonia | .00 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 72.11 | " |
| | 100.00 | |

*Value per ton 2000 pounds.*

| | | | |
|---|---|---|---|
| 389.2 | pounds | Soluble Phosphoric Acid | 63.25 |
| | | Returned " " | .00 |
| 168.6 | " | Insoluble " " | 10.12 |
| | | Ammonia | .00 |
| | | | $73.37 |

NO. 15.

Name: AMMONIATED GREEN MOUNTAIN SOLUBLE PHOSPHATE.

*Received from Geo. W. Beckwith, Burlington.*

| | | |
|---|---|---|
| Soluble Phosphoic Acid | 18.68 | per cent. |
| Returned " " | .00 | " |
| Insoluble " " | 8.09 | " |
| Ammonia " | 1.03 | " |
| Plaster, Sand, Water, Organic Matter &c., | 72.20 | " |
| | 100.00 | |

*Value per ton of* 2000 *pounds.*

| | | |
|---|---|---|
| 373.6 | pounds Soluble Phosphoric Acid | $60.71 |
| | " Returned " " | .00 |
| 161.8 | " Insoluble " " | 9.71 |
| 20.6 | " Ammonia | 5.15 |
| | | $75.57 |

No. 16.

Name: PADDOCK & DEAN'S SUPERPHOSPHATE.

*Received from Hiram A. Cutting, Lunenburgh.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | .35 | per cent. |
| Returned " " | 1.81 | " |
| Insoluble " " | 2.71 | " |
| Ammonia | 1.49 | " |
| Plaster, Sand, Water, Organic Matter, &c., | 93.64 | " |
| | 100.00 | |

*Value per ton of* 2000 *pounds.*

| | | |
|---|---|---|
| 7.0 | pounds Soluble Phosphoric Acid | $1.14 |
| 36.2 | " Returned " " | 4.78 |
| 54.2 | " Insoluble " " | 3.25 |
| 29.8 | " Ammonia | 7.45 |
| | | $16.62 |

NO. 17.

Name: BRIGHTON BONE PHOSPHATE.

*Received from Manufacturers, Boston, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 3.48 | per cent. |
| Returned " " | 8.69 | " |
| Insoluble " " | 1.57 | " |
| Ammonia " " | 1.86 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 84.40 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 69.6 | pounds Soluble Phosphoric Acid | $11.31 |
| 173.8 | " Returned " " | 22.94 |
| 31.4 | " Insoluble " " | 1.88 |
| 37.2 | " Ammonia | 9.30 |
| | | $45.43 |

NO. 18.

Name: BRIGHTON BONE PHOSPHATE.

*Received from the Manufacturers, Boston, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 8.38 | per cent. |
| Returned " " | 9.55 | " |
| Insoluble " " | 2.57 | " |
| Ammonia " " | 2.42 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 77.08 | " |
| | 100.00 | |

*Value per ton 2000 pounds.*

| | | |
|---|---|---|
| 167.6 | pounds Soluble Phosphoric Acid | $27.23 |
| 191.0 | " Returned " " | 25.21 |
| 51.4 | " Insoluble " " | 3.08 |
| 48.4 | " Ammonia " " | 12.10 |
| | | $67.62 |

## NO. 19.

Name: BRIGHTON TOBACCO GROWER.

*Received from Manufacturers, Boston, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | .69 | per cent. |
| Returned " " | 10.79 | " |
| Insoluble " " | 1.45 | " |
| Ammonia " " | 1.87 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 85.20 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 13.8 | pounds Soluble Phosphoric Acid | $ 2.24 |
| 215.8 | " Returned " " | 28.49 |
| 29.0 | " Insoluble " " | 1.74 |
| 37.4 | " Ammonia | 9.35 |
| | | $41.82 |

## NO. 20.

Name: WILSON'S SUPERPHOSPHATE.

*Received from Ross & Co., Northfield, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 3.86 | per cent. |
| Returned " " | 5.05 | " |
| Insoluble " " | 1.50 | " |
| Ammonia | 3.40 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 86.19 | " |
| | 100.00 | |

*Value per ton 2000 pounds.*

| | | |
|---|---|---|
| 77.2 | pounds Soluble Phosphoric Acid | $12.54 |
| 101.0 | " Returned " " | 13.33 |
| 30.0 | " Insoluble " " | 1.80 |
| 68.0 | " Ammonia | 17.00 |
| | | $44.67 |

## NO. 21.

Name: WILSON'S TOBACCO GROWER.

*Received from Ross & Co., Northfield, Mass.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 3.45 | per cent. |
| Returned " " | 3.69 | " |
| Insoluble " " | 1.01 | " |
| Ammonia | 2.25 | " |
| Plaster, Sand, Water, Organic Matter, &c., | 89.60 | " |
| | 100.00 | " |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 69.0 | pounds Soluble Phosphoric Acid | $11.21 |
| 73.8 | " Returned " " | 9.74 |
| 20.2 | " Insoluble " " | 1.21 |
| 45.0 | " Ammonia | 11.25 |
| | | $33.41 |

## NO. 22.

Name: BOWER'S COMPLETE MANURE.

*Received from J. L. Fletcher, St. Johnsbury.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 2.73 | per cent. |
| Returned " " | 8.08 | " |
| Insoluble " " | 12.67 | " |
| Ammonia | .69 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 75.83 | " |
| | 100.00 | |

*Value per ton 2000 pounds.*

| | | |
|---|---|---|
| 54.6 | pounds Soluble Phosphoric Acid | $8.87 |
| 161.6 | " Returned " " | 21.33 |
| 253.4 | " Insoluble " " | 15.20 |
| 13.8 | " Ammonia | 3.45 |
| | | $48.85 |

NO. 23.

Name: UNION FERTILIZER.

*Received from J. L. Fletcher, St. Johnsbury.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | .00 | per cant. |
| Returned " " | .00 | " |
| Insoluble " " | 1.65 | " |
| Ammonia " " | .88 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 97.47 | " |
| | 100.00 | |

*Value per ton 2000 pounds.*

| | | |
|---|---|---|
| .0 | pounds Soluble Phosphoric Acid | .00 |
| .0 | " Returned " " | .00 |
| 33.0 | " Insoluble " " | 1.98 |
| 17.6 | " Ammonia | 4.40 |
| | | $6.38 |

NO. 24.

Name: CUMBERLAND SUPERPHOSPHATE.

*Received from T. H. Hoskins, Newport.*

| | | |
|---|---|---|
| Soluble Phosphoric Acid | 5.55 | per cent. |
| Returned " " | 3.78 | " |
| Insoluble " " | 4.92 | " |
| Ammonia " " | 3.07 | " |
| Plaster, Sand, Water, Organic Matter, &c. | 82.68 | " |
| | 100.00 | |

*Value per ton of 2000 pounds.*

| | | |
|---|---|---|
| 111.0 | pounds Soluble Phosphoric Acid | $18.04 |
| 75.6 | " Returned " " | 9.88 |
| 98.4 | " Insoluble " " | 5.90 |
| 61.4 | " Ammonia " " | 15.35 |
| | | $49.17 |

NO. 25.

Name: CUMBERLAND SUPERPHOSPHATE.

*Received from L. Pease & Son, Hartford.*

| | | | |
|---|---|---|---|
| Soluble Phosphoric Acid | | 5.35 | per cent. |
| Returued " " | | 4.86 | " |
| Insoluble " " | | 3.18 | " |
| Ammonia " " | | 2.49 | " |
| Plaster, Sand, Water, Organic Matter, &c. | | 84.12 | " |
| | | 100.00 | |

*Value per ton of* 2000 *pounds.*

| | | |
|---|---|---|
| 107.0 | pounds Soluble Phosphoric Acid | 17.39 |
| 97.2 | " Returned " " | 12.83 |
| 63.6 | " Insoluble " " | 3.82 |
| 49.8 | " Ammonia " " | 12.45 |
| | | $46.49 |

NO. 26.

Name: WATSON & CLARK'S SUPERPHOSPHATE.

*Received from Manufacturers, Philadelphia, Pa.*

| | | | |
|---|---|---|---|
| Soluble Phosphoric Acid | | 6.06 | per cent. |
| Returned " " | | 2.66 | " |
| Insoluble " " | | 3.46 | " |
| Ammonia " " | | .75 | " |
| Plaster, Sand, Water, Organic Matter, &c. | | 87.07 | " |
| | | 100.00 | |

*Value per ton of* 2000 *pounds.*

| | | |
|---|---|---|
| 121.2 | pounds Soluble Phosphoric Acid | 19.69 |
| 53.2 | " Returned " " | 7.02 |
| 69.2 | " Insoluble " " | 4.15 |
| 15.0 | " Ammonia " " | 3.75 |
| | | $34.61 |

### NO. 27.

Name: GRAFTON MINERAL FERTILIZER.

*Received from Hiram A. Cutting, Lunenburgh.*

| | | |
|---|---|---|
| Silica | 39.87 | per cent. |
| Carbonic Acid | 26.97 | " |
| Sulphur | .25 | " |
| Lime | 16.95 | " |
| Magnesia | 9.52 | " |
| Oxide of Iron | 6.44 | " |
| Manganese, Zinc, Alumina, &c. | traces, | " |
| | 100.00 | |

VALUATION.

To the several constituents present in the above, agriculturists have never yet assigned any value, and of course there exists therefore no basis upon which to fix a price. Very careful experiments are needed to show that as a fertilizer it is worth a dollar a ton.

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### NO. 28.

Name: STEVENS' MINERAL FERTILIZER.

*Received from T. H. Hoskins, Newport.*

| | | |
|---|---|---|
| Silica | 97.61 | per cent. |
| Carbonic Acid | .94 | " |
| Lime | .03 | " |
| Magnesia | .04 | " |
| Iron Oxide | 1.38 | " |
| | 100.00 | |

VALUATION.

The fertilizing value of the above is of the same character as that of the Grafton Mineral Fertilizer. Whatever may be its effects upon the plant, it seems in the highest degree improbable that either it, or the Grafton Mineral Fertilizer, are of any value as affording direct food to the growing plant.

## REMARKS.

In reference to the analyses given, it is to be remembered that the "plaster, sand, coal, water, organic matter, &c.." which make up the greater part by far of most of the superphosphates, is not absolutely worthless, but comparatively so, since as has been remarked on page 451 there is present in each a variable amount of plaster, approximately three times the weight of soluble phosphoric acid present, and the value of this at $10 per ton may very properly be added to the total value of the superphosphate, though generally it is not taken into account in published analyses, and therefore not included here.

There is present also in certain ones a small quantity of potash, which may be reckoned at 7 cents per pound, and added to the above prices. No's. 19, 21 and 22 containing notable quantities, No. 19 having 0.81 per cent.; No. 21, 3.55 per cent., and No. 22, 0.95 per cent., which would add to the total of No. 19 $1.13, to No. 21 $4.97, and to No. 22 $1.33.

It will also be observed that in many of the analyses the phosphoric acid is to a great extent in the *returned* condition, and that in few of them does the proportion of *soluble* to *returned* stand in the ratio of 2 to 1, as recommended by the convention of German agriculturists and manufacturers, (Vide page 443.)

Attention is also called to the very large proportion of insoluble acid existing in No's. 1, 3, 4, 5, 6, 7 and 22, which can only arise from a too sparing use of oil of vitriol in the manufacture.

## TABULATED ANALYSES OF COMMERCIAL FERTILIZERS AND VALUES.

| PER CENTAGE COMPOSITION. | Fales' Fertilizer | Miles & Co.'s | Bradley's X. L. | Bradley's B. D. | Bradley's B. D. | Bradley's Patent | Bradley's Patent | Bradley's Patent | Enoch Coe's | E. Frank Coe's | Russell Coe's | Canada Superphos. | Canada Superphos. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. | No. 6. | No. 7. | No. 8. | No. 9. | No. 10 | No. 11 | No. 12 | No. 13 |
| Soluble Phosphoric Acid | .64 | 8.59 | 5.95 | 4.85 | 5.29 | 4.53 | 1.49 | 6.44 | 9.76 | 7.85 | 6.19 | 7.23 | 12.96 |
| Returned " " | 1.15 | .00 | .55 | 1.05 | 2.84 | 2.63 | 4.50 | 2.75 | 1.37 | 5.76 | 6.28 | .22 | 1.46 |
| Insoluble " " | 5.39 | .41 | 5.30 | 6.81 | 7.61 | 7.29 | 6.89 | 3.40 | 1.10 | 4.60 | 2.75 | 3.07 | 6.56 |
| Ammonia | 2.58 | 2.88 | 2.96 | 2.93 | 2.13 | 3.25 | 2.17 | 3.01 | 2.89 | 3.05 | 1.36 | 1.93 | 2.17 |
| Plaster, Sand, Water, Organic Matter, &c. | 90.24 | 88.12 | 85.24 | 84.36 | 82.13 | 82.30 | 84.95 | 84.40 | 84.88 | 78.74 | 83.42 | 87.55 | 71.85 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Soluble Phosphoric Acid, | $2.08 | $27.92 | $19.34 | $15.76 | $17.19 | $14.72 | $4.84 | $20.93 | $31.72 | $25.51 | $20.11 | $23.50 | $42.12 |
| Returned " " | 3.04 | .00 | 1.45 | 2.77 | 7.50 | 6.94 | 11.88 | 7.26 | 3.62 | 15.21 | 16.58 | .58 | 3.85 |
| Insoluble " " | 6.47 | .49 | 6.36 | 8.17 | 9.13 | 8.75 | 8.27 | 4.08 | 1.32 | 5.52 | 3.30 | 3.68 | 7.87 |
| Ammonia | 12.90 | 14.40 | 14.80 | 14.65 | 10.65 | 16.25 | 10.85 | 15.05 | 14.45 | 15.25 | 6.80 | 9.65 | 10.85 |
| Total value | $24.49 | $42.81 | $41.95 | $41.35 | $44.47 | $46.66 | $35.84 | $47.32 | $51.11 | $61.49 | $40.79 | $37.41 | $64.69 |

## TABULATED ANALYSES OF COMMERCIAL FERTILIZERS AND VALUES.

| PER CENTAGE COMPOSITION. | Green Mountain...... | Green Mountain Amm. | Paddock & Dean's..... | Brighton Phosphate... | Brighton Phosphate... | Brighton Tob. Grower. | Wilson's Superphos.... | Wilson's Tob. Grower.. | Bower's Manure...... | Union Fertilizer ...... | Cumberland........... | Cumberland........... | Wattson & Clark's..... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. 14 | No. 15 | No. 16 | No. 17 | No. 18 | No. 19 | No. 20 | No. 21 | No. 22 | No. 23 | No. 24 | No. 25 | No. 26 |
| Soluble Phosphoric Acid.............. | 19.46 | 18.68 | .35 | 3.48 | 8.38 | .69 | 3.86 | 3.45 | 2.73 | .00 | 5.55 | 5.35 | 6.06 |
| Returned " " .............. | .00 | .00 | 1.81 | 8.69 | 9.55 | 10.79 | 5.05 | 3.69 | 8.08 | .00 | 3.78 | 4.86 | 2.66 |
| Insoluble " " .............. | 8.43 | 8.09 | 2.71 | 1.57 | 2.57 | 1.45 | 1.50 | 1.01 | 12.67 | 1.65 | 4.92 | 3.18 | 3.46 |
| Ammonia.......................... | .00 | 1.03 | 1.49 | 1.86 | 2.42 | 1.87 | 3.40 | 2.25 | .69 | .88 | 3.07 | 2.49 | .75 |
| Plaster, Sand, Water, Organic Matter, &c. | 72.11 | 72.20 | 93.64 | 84.40 | 77.08 | 85.20 | 86.19 | 89.60 | 75.83 | 97.47 | 82.68 | 84.12 | 87.07 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Soluble Phosphoric Acid.............. | $63.25 | $60.71 | $1.14 | $11.31 | $27.23 | $2.24 | $12.54 | $11.21 | $8.87 | $.00 | $18.04 | $17.39 | $19.69 |
| Returned " " .............. | .00 | .00 | 4.78 | 22.94 | 25.21 | 28.49 | 13.33 | 9.74 | 21.33 | .00 | 9.88 | 12.83 | 7.02 |
| Insoluble " " .............. | 10.12 | 9.71 | 3.25 | 1.88 | 3.08 | 1.74 | 1.80 | 1.21 | 15.20 | 1.98 | 5.90 | 3.82 | 4.15 |
| Ammonia.......................... | .00 | 5.15 | 7.45 | 9.30 | 12.10 | 9.35 | 17.00 | 11.25 | 3.45 | 4.40 | 15.35 | 12.45 | 3.75 |
| Total value.......... | $73.37 | $75.57 | $16.62 | $45.43 | $67.62 | $41.82 | $44.67 | $33.41 | $48.85 | $6.38 | $49.17 | $46.49 | $34.61 |

## REMARKS.

In making the above analyses an effort was made to secure samples of each fertilizer from two or more different parties in order to test the regularity of composition of the products of the various manufactories; and the importance of this may be seen by comparing the analyses No's. 7 and 8 of the same brand: No's. 12 and 13, No's. 17 and 18, in which the total values are respectively as 100 to 132, 100 to 173, and 100 to 149.

Attention is also directed to the analysis No. 7, since it will be found to agree very closely with an analysis of the same superphosphate made by Prof. Johnson, and published in the report of the Connecticut Board of Agriculture for 1868, page 224. This analysis of Prof. Johnson not having given the amounts of returned phosphoric acid, but including all not soluble in water as insoluble, made the total value of the sample analyzed much less than in justice it should have been, although as may be seen by comparison No. 7 is far less valuable than either No. 6 or No. 8.

In making the above analyses I have been assisted throughout by Mr. John A. Collier, Assistant in the Laboratory of the University of Vermont and State Agricultural College.

# RELATIONS OF SCIENCE TO AGRICULTURE.

I think if we make careful inquiry we shall find, that the ancient philosopher put the widest possible distance between his philosophy and the useful arts and occupations. To his mind there was probably not the slightest connection, one with the other. Thought and labor were as distant as the poles; or if there was the slightest relationship, it was that of master and servant: thought, or as we may embody it, philosophy, regarded labor as a menial, fit only to do its bidding.

Whenever the philosopher penetrated the mysteries of nature, the discoveries he made were for himself, or for a favored few; and not in any way a contribution for his fellows. So to the people in general, science was but a speculation, a dream, which had not any interest or value to them.

A natural antagonism would thus be engendered, and so long as this existed, neither science nor art could come to its complete fulness.

Science was too proud to help man upward if it could; labor or art, too dull and discouraged to raise itself, had not the power if it would. It was only by harmonizing these discordant parties that the beneficence of both could be bestowed upon mankind. Philosophy must lay aside its assumed supremacy, art must assert its true position, and these

enthroned together must rule, not as tyrants, but as benefactors of the human race. A plea like that of the old time prince and patriarch: "We are brethren; let there be no strife between us," could alone reconcile those so at enmity.

And has not already this happy day of reconciliation arrived? Science has seen its fault and acknowledged it too. Now thought and labor, or head-work and hand-work, reign most harmoniously. Not as before is every discovery kept within the knowledge of few, but every revelation from the arcana of nature becomes the property of all; and the earnest thought is, how shall it be economized and bring convenience and comfort or profit to all. Science has removed its exclusiveness and is now the servant of all, and so far as it serves all, is the greatest and noblest of all.

Its mission is to a thousand millions of men. Its presence is felt in every art, in every trade, and in every profession.

For commerce, science is revealing the laws of the winds of heaven; is reading the statutes that rule the fickle wave, and the headstrong current of the ocean; is sending down its arm into the cold depths, and feeling among chasms and shoals; and the ocean, the highway of nations, becomes as familiar as a daily path.

On land are found the results of the researches of science that vie with those that are among the wonders of the deep. The way that on the ocean was a wave is here of iron. Along its lines with the speed of wind, rushes the wealth of sea and land, while at its side on fairy rails, swifter than the wind, go the loaded trains of thought. Mountain or river is but a slight obstacle in the progress of travel; rather by them are offered new fields for thought, invention, and successful endeavor.

To the manufacturer and the artisan, science has been most liberal in its favors. The cloth as it comes from the

loom, surpassing the fine linen of olden time, puts on that grace of finish and beauty of color that seems the result of magic. Formerly acres of the best meadow land in the vicinity of manufacturing towns were covered by cotton and linens spread out to bleach. Now in the space of a few days, and within the compass of a few roods, the same result is accomplished and in a degree of perfection before unattainable. This one illustration must represent a host of instances that leap to the thought when the subject is only even hinted at.

If scientific research confer such liberal benefits on commerce, mapping out the course of wind and wave, and flashing from every rock that danger is there; if on the land it gives speed to thinkers and lightning to thought; if to the manufacturer, it is the philosopher's stone turning whatever it touches into gold; if to the stroke of the artisan it lends power, and makes and moulds to his fancy; if it descends the shaft with the miner, and goes with him while he breathes unharmed the breath coming fresh from the jaws of death; if to the physician it gives a charm that makes him pass unscathed through contagion and malaria; if, in short, its powerful influence is felt by every profession and art and occupation, it may not be inappropriate, in an agricultural community, to make earnest inquiry in regard to its connection with the pursuit in which so many are interested. Let us then notice these relations.

### THE RELATIONS OF SCIENCE AND AGRICULTURE.

Two hundred millions of men are supposed to be actively engaged in the culture of the earth, or in occupations that minister directly to the sustenance of mankind. Has science a mission to this multitude? Is the hand, that is opened

to dispense untold favors to other classes, here scattering gifts as generously ?

That agriculture has not derived from classified knowledge the assistance that has been given to the arts is obvious to all. Some of the causes of this seeming neglect are evident on a little thought. The complexity of the problem of the application of science to agriculture appears at once. If the value of an ore is to be known, the proportions of its constituents are determined with unerring accuracy. If a piece of cloth is to receive a certain color, mordant and dye are measured out, and the thing is done. But in that that lives, there is a controlling power, a vital principle, which lies beyond the power of man, and concerning this no rigid rules, no unvarying deductions can be formed. Man must observe and experiment and wait. And after waiting, the most careful conclusions may be entirely overruled by the circumstances of soil, and climate, of wind and weather. And because science has not, from the nature of the case, been able to give the fixed rules which the agriculturist at once demanded, all scientific deductions have been discarded ; theory, however reasonable, has been despised ; while the maxims of practice alone have been considered of value. The field of scientific agriculture was for a time so unpromising that few would care to cultivate it.

But the connection between science and agriculture has become so plain that it can be no longer neglected. "Practical men are becoming anxious to receive instruction ; scientific men are ready to impart what they know, and eager to undertake new researches, for the purpose of clearing up what is unknown."

The different branches of science are already beginning to bear fruit, though the tree is yet mostly in the bloom,

beautiful in itself but eminently so in view of the promised harvest.

And what are those departments of science most intimately connected with the progress of agriculture? Some of these having the closest relation I may mention.

*Geology*, "the science that treats of the structure and mineral constitution of the globe," is a popular study, and is claiming the attention of practical men. It reveals the origin and character of the soil,—the soil that at once furnishes sustenance and a home for the plant. It teaches that the soil comes from the worn, the weathered, and the dissolved rocks. And knowing the rock from which the soil originated, the observer can arrive at a general conclusion as to the constitution of the soil itself. And still while he learns the general fact that the soil is of the nature of the rock from which it has been formed, he will also learn that the debris of the decomposed socks do not always, or even usually, lie upon the surface or sides of those rocks, but by the transporting agency of water have been widely mingled and distributed.

Thus the soil of our lake towns, as Bridport and Shoreham, did not originate from the limestone beneath, but came largely from the mountain elevations, and was poured chiefly through the Winooski and valleys of the north.

But the revelation of the origin of the soil is not all that geology has done or will do for the farmer. It has sought out strata from limestone, deposits of gypsum, and accumulations of peat and marl which are laid up in store for our present or future wants. It has gone abroad, and discovered valuable fertilizers; guano on the islands of the Peruvian coast; nitrate of soda in Chili, and phosphorite in the islands of the Caribbean sea. Economic geology is occupying the thoughts of some of the best European, as well as

American, scientific men, and their labors will result in immense advantage to the farming interest.

*Chemistry*, the science which discloses the intimate and invisible constitution of matter, has an acknowledged and direct bearing on the progress of agriculture. The labors of Liebig and Stockhart, of Boussingault, of Lawes and Gilbert, of Johnston and Johnson, and allied workers, are becoming more thoroughly appreciated. It must be acknowledged that mist and doubt still hang around many subjects, but these we can reasonably hope chemical research will eventually dispel.

Much was expected from the analysis of the soil as well as the analysis of the ash of plants. Here imagination run wild. The ash of the plant was that part taken up from the soil; and if analysis showed the soil wanting in any constituent, why, add this constituent and a constantly fertile soil and a generous crop would be the result. Such was the hasty deduction of theory.

But a handful of earth, taken from a farm in Connecticut which required constant enriching to procure a scanty crop, showed a composition almost identical with that received from the valley of the Miami, from which year after year an undiminished harvest is gathered.

Here theory has not gone far enough. Observation and experience say that fertility not only depends on chemical constitution, not only on the materials of which it is made up, but also on the physical condition, or the state in which the materials exist. Thus a large rock may contain all the mineral elements of a fertile field, yet it will be only covered by lichens and moss, the lower forms of vegetable life. If the rock be broken into pieces, more surface will be exposed and a larger crop of moss will be sustained. If it be pulverized to a fine sand, a barren soil will be produced, from which will grow

some of the more hardy shrubs and grasses. But if it be ground to an impalpable powder and a small quantity of vegetable matter be added, a rich valuable soil will be the result. The coarse particles of earthy matter dissolve slowly in the water that falls as rain upon them; the fine rapidly; so there is obtained in one case a starved, in the other a full and profitable crop.

It is not to be understood, however, that the analysis of soils and plants has had no influence on agriculture. On the other hand, scientific agriculture made rapid advancement, when by the aid of analysis, the relation of the soil and the plant was more fully discovered. Much general knowledge is obtained by analysis, and not unfrequently this knowledge can be made of great utility in special cases. Take an illustration. Clover, while growing, takes up much lime and sulphuric acid; and when a field is deficient in these substances, the crop will be materially benefited by a dressing containing them. Now gypsum, or common plaster, contains both lime and sulphuric acid, and remarkable effects are sometimes seen by a timely application of this valuable fertilizer.

And in this connection, and just here, I may mention the benefit which chemistry is conferring on the farmer; this in determining the economy of purchasing certain natural and artificial manures. The time may not have come when we may follow the example of the English farmers, who put more confidence in the soil than they do in the banks, and instead of depositing their surplus in moneyed institutions, deposit it in the soil in the form of rich fertilizers, and are well satisfied with the investment; yet we should look with diligence for new and effectual means of keeping up, or restoring, the original fertility and productions of the soil.

When the value of guano was determined, the high farm-

ing of England created a great demand for this, as well as other materials for enriching the soil. Unscrupulous men, taking advantage of this state of things, pulverized the red sandstone rock, mingled with it a trifling quantity of guano, and sent it out to the unsuspecting farmer, bearing the Peruvian government brand, and every usual mark to give proof of its genuineness. This is only one out of a multitude of cases in which a worthless material has been sent out for home or foreign consumption.

It would be fortunate if such adulterations and frauds were practiced only by Englishmen. But in our older and seaboard States, where the abundant use of enriching materials is necessary, the farmer was for a long time at the mercy of any man who might choose to engage in the sale or manufacture of manures. And American genius and especially Yankee ingenuity are not always scrupulous as to the manner in which their gain is made.

The agricultural chemist refusing the sample that the interested manufacturer offers for analysis, goes to the barrel or sack which the farmer has purchased, and then sits as judge of its quality and value.

Through the agricultural press the honest manufacturer will receive his due, while the unprincipled maker will be held up as an example and terror to evil doers, and both he and his vile compound will be driven from good society.

The time when fertilizers can be most profitably employed, and the form in which they should be applied, comes largely under the cognizance of chemistry. Is there a critical period in the growth of a crop when an application will supply a pressing want? May not our harvest in some such way be doubled? What transformations may be made after the harvest is gathered? Can the starch which differs so little from cane sugar be trans-

formed into this sugar? A thousand practical questions start up at once which chemistry alone can solve. And in practically solving even single ones of these, one hundred per cent. will be added to the value of the farmer's home.

When asked what we should do when our great stores of fertilizers and mines of coal are gone, a German chemist triumphantly replies, "We shall enrich our fields with the air, and for fuel burn water." I prefer to regard this answer as a prophecy, rather than a thoughtless boast.

*Botany* holds a near relation to the farmer's profession. Wonderful are the changes that cultivation effects on almost everything that grows from the earth. Under the application of labor, worthless grasses enlarge their seeds, and in their heads concentrate food for man, giving us our most valued cereals. The wild fruit tree by improvement through generations becomes loaded with the luscious peach or melting pear. There seems a magic in the touch of man, which in the vegetable world transforms the worthless and ever hurtful into ministers of comfort and health. But it is not the result of magic that we behold—it is the reward of obedience to the high mandate, "subdue the earth."

But more wonderful than all this are the processes that are going on in the quiet laboratory of the plant, where sun and leaf, root and stem, out of the same earth, water and air, transform ten times ten thousand substances.

Agriculture asks of botany more than a mere classification of plants; more than an enumeration under genera and species. It seeks to know concerning their physiological character—their structure and growth. It requires information in regard to the hardiest and most productive varieties of plants under cultivation in our own country, and makes inquiry as to the probable success of foreign plants

when introduced upon our own soil. The agriculturist wishes to know the character of the new weeds that may be coming in like a flood upon his farm, and the best methods of combating them. Those scourges that cut short the hope of the farmer, the rust, and smut, and blight, and rot, and mildew, deserve the most careful investigation of the botanist. Remedies for the ravages of these and all parasites that destroy or decimate the growing plants will be most gratefully accepted from the hand of the botanist.

The rearing and management of farm stock is no mean item in practical husbandry.

*Zoology*, the science that treats of animals, takes these matters under its consideration. It points out the power that man has at his control over the lower animals. It looks with complaisance on the popular breeds, and compares our Devons and Short Horns with the neglected kinds—our Suffolk and Berkshire with the wild hog. It questions whether we may not obtain other useful and faithful servants. It asks for the introduction of some new beast of burden, combining all the valuable points of the horse, camel, and ox; endowed with fleetness, endurance, and patience; valuable while living, and scarcely less so when dead; nor is willing to be satisfied until those animals, which are the peculiar gift of this continent, the swift and hardy moose, the noble elk, and other untamed denizens of our northern and western lands, have been taken from their pastures, and for generations submitted to the transforming influence of the hand of man.

But there is a division of this science that must not be overlooked. Blight and rust and mildew are not the only enemies with which the farmer has to contend while his crop is maturing. From the time the seed is covered in the soil until it is harvested, it is subject to the ravages of hordes of

voracious insects. Of the habits of these insects, of their propagation, their changes, as well as their destruction, *Entomology* treats. It is thus intimate with agriculture.

A farmer, selecting perhaps the most fruitful of his fields, has day after day followed the plough, turning the deep, rich furrow. On the mellow soil the wheat falls in a shower from his generous hand, and, springing up, attests how well he has done his work. The crop endures the winter well, and is ready to start under the first genial suns of spring. The ground is cleared of weeds, and nothing is left to check the growth of the plants. Leaf after leaf develops, until the field is a wavy sea of green, and as the light spring breezes course over it, their path is disclosed by the brightening and darkening of the nodding blades. Joint after joint is pushed up until the pennant leaf, appearing above all, bears in its embrace the hope of the farmer, the head of the wished-for grain. This bursts its swaddling bands, then sends out its delicate bloom, then hides within its chaffy shields the tender, milky grain. Rich in promise is that beautiful field. The sun and showers are well appointed, and the farmer already rejoices in the assurance of the reward of his labor. The days when it will be harvested and garnered can almost be counted. Room in the old gray barn for the coming crop!

But with the blossom of the wheat, or its early milky state, has come a little two-winged fly, an orange colored gnat, much like a mosquito in form, but a very little thing. If you have a hand glass you will be able to examine it more minutely. You will see that it has long, slender, pale yellow legs, and two transparent wings, reflecting in the light the tints of the rainbow. Its eyes are black and prominent, its face and feelers yellow, its antennæ long and

blackish. This little midge hovers over a head of wheat, settles upon it, and within the green scales deposits its eggs. In a few days these hatch, and the little buff colored worms find themselves in a luxurious home, an insect paradise. They attach themselves to the soft, milky berry, and their luxurious living shows itself in their increasing size. Not so the kernel. The rich juices sent up by stem and leaf to be stored away in the ripening grain, do not fill their appointed duty, for the life-blood of the berry is drawn away by these voracious leeches. The kernel shrinks away and dies. Its cradle becomes its grave, in which corruption and worms revel together.

It is true that one little fly and one grain of wheat are but trifles in themselves, but they stand as representatives of what has been going on through a whole field, and more, through a whole district. That fly was but one of a numberless host. With the shrinking and dying of that one kernel, the hope of the farmer departed, for his whole harvest was attacked, smitten, lost. Over a whole region of country the scourge has passed and the crop is destroyed.

If some one turning aside from the more severe labors of his profession, has devoted his leisure hours to the study of this little insect, and learning its habits, has been able to devise a way, ready and unfailing, by which its ravages can be prevented, he has been doing no trifling work. Worthy is he of honor, and shall receive the unmeasured gratitude of the farmer.

There is an undeveloped offshoot of natural philosophy in which the agriculturist has a deep concern, and that is *Meteorology*, which treats of the atmosphere and its phenomena. A late or an early frost may in one night blast the prospect of a harvest; a continual rain may ruin the labor of a season. The laws of the winds, their going out

and their coming in, science has to some extent disclosed. Year by year, more and more is known. Though we may never be able to compel the sky to send down rain at our call, or the frost to flee at our word, still we can to some extent equalize the fall of showers, and mitigate the severity of the frost.

The change of temperature and consequent production of winds is a source of utility at once evident to all. Commerce flourishes under prosperous gales, and the agricultural products of one country are exchanged for those of another. "The winds give us salubrious air for that which has become vitiated, and the fierce tempest may be a messenger of mercy sent to blast the seeds of pestilence and contagion."

It is the winds, in their beneficent, yet quiet character, which especially call forth the gratitude of the farmer. From the great fountain source of waters—the ocean—an imperceptible mist goes up, is received by the gentle winds, and carried over the land. A *cold* atmosphere cannot hold up as much moisture as a *warm* one, and the warm air of the ocean meeting with a cold current or a colder mountain top, sends down its precious burden, giving to the farmer "the *former* and the *latter* rain."

The great deserts are such not usually from an inherent barrenness, but simply from the force of circumstances; the great circumstance being the refusal of the sky to give up its moisture. Around the fountain of the desert there is an oasis. It is confidently asserted by those whose opinion is fully worthy of our regard, that if a mountain or a mountain chain, were by any convulsion of nature pushed up in Zahara into the regions of eternal frost, those sterile plains would bloom like a garden. The cold mountain tops would condense the moisture that the avaricious winds now

bear in their embrace to other parts, while down the sloping sides, rivulets and rivers would carry grateful draughts to the thirsty land.

The value of snow can scarcely be overestimated. It protects our rivers and streams, retards the advance and tempers the severity of the cold; forms a warm covering to the soil, imprisons the heat in the ground, and defends vegetation from the rigors of the frost. "The snow gathered in exhaustless store upon the high mountains of the globe, feeds, as it gradually melts beneath the heat of summer, thousands of rivers which, flowing on from clime to clime, enrich the soil and crown the land with plenty."

And *dew*, that silent messenger to the needy plant in a parched soil, meteorology teaches us to prize. The tumbler filled with cold water, in a warm room, is the standard illustration of the deposition of dew. But to the meteorologist, the cooling earth replaces the tumbler, and the room is bounded only by the canopy of heaven. Where most needed, it comes as though it were endowed with choice. "Lake and river are not visited by it, it scarcely stops upon the barren rock, it passes over the naked soil, but goes on to the tender herbage and bladed grain, which it blesses with all its invigorating exuberance."

They tell us that our climate has changed, that our summers are drier, that our streams are smaller. Perhaps our own observation will instance cases, where a once living spring has become dry, or where an ever flowing stream yearly grows less. Are we at all accountable for these results?

"Woodman spare that tree" is not the voice of song alone. The meteorologist repeats the plea, and adds, " touch not a single bough." That the extensive destruction of the forests of a country lessens the quantity of running water the

observations of Humboldt, Boussingault and others, have established beyond a doubt.

Cultivation may demand the prudent clearing of lands, but does not nature cry out against the vandalism, the war of extermination, that is waged against our noble martyr forests? The interests of the agriculturist demand that our trees be sacred, that we plant but not wantonly destroy.

Thus I notice some of the sciences that have a direct bearing on the farmer's profession; Geology and Chemistry, teaching of the soil—the home of the plant—its physical properties and intimate constitution; Botany treating of what grows up from the soil; Zoology and Entomology giving a knowledge of the animals that economize, and the insects that destroy the fruit of our labor; and Meteorology making us acquainted with the influence of the climate on our products; and for these I ask the respectful consideration of our agriculturists. Not that the knowledge of all these will make a farmer, but these encouraged and consulted will add both to his financial and intellectual capital. I do not ask that experience be discarded, or that untried theories be adopted without question, but I do plead that the contributions of science be accepted and acknowledged. Let agriculture be no longer suspicious of science, but test its theories and reduce to practice its researches. Then science will respond to the questions of agriculture, and as far as possible solve its doubts. Let the hand and the head work together, let thought and labor be intimate.

Science has girded itself for its appointed mission. It is reliant on its strength, confident in its success, but now modest in its claims. *Good will* is inscribed on the olive branch it bears. In its giant strength it goes forth in charity. To agriculture and the arts that minister to man, it comes not in the pride of its power, but with the humility of a child, and

claiming its relationship asserts its brotherhood, and repeats, henceforth let there be no strife between us.

Albert Chapman, Esq., of Middlebury, spoke earnestly in favor of Farmers' Clubs, pointing out their obvious advantages and showing the loss that accrues to a farming community by the neglect in this particular.

Mr. Douglass remarked upon the indifference of farmers to improvement, and the benefit they would receive from a careful study of their business. There was profit in this knowledge. Science imparts the power to ensure good crops in unfavorable seasons. He urged the formation of a Farmers' Club in Middlebury, saying that no place in the State afforded better material for an effective and useful organization of that kind.

Mr. Wright supported the same view. He said that unfortunately there was a jealousy among farmers that seemed to act as an obstacle to union and stand in the way of co-operation. Some think this jealousy is a good thing, because if farmers did unite they would control the world. Well, they are the majority, and they have the right to rule. At any rate they could get their rights if they would pull together, and they have never had them yet. He did not think there was any danger that farmers would tyrannize over the rest of the community, even if they had the power.

In reply to questions, Prof. S. gave several instances of the benefit derived by agriculture from the investigations of science. He especially referred to the experience of Mr. Geddes, of Onondaga County, (N.Y.,) with the wheat midge, by which it was shown that this insect never appeared before a certain period in the season, and that by sowing an early variety, like the Mediterranean, its ravages could be entire-

ly escaped, as the wheat was out of the milk before the midge appeared.

Prof. Collier also gave some interesting accounts of similar discoveries, referring particularly to Pasteur's investigations into the silk worm disease, by which the silk growing industry of France was preserved from utter ruin.

# AGRICULTURE AS A FIELD FOR HUMAN DEVELOPMENT.

A PAPER READ AT THE MEETING OF THE VERMONT STATE BOARD OF AGRICULTURE AT MIDDLEBURY, BY

HON. F. D. DOUGLASS, OF WHITING.

Human development is subject to laws and conditions which were established by the Creator, and like all his works are fixed and unchangeable. It is only by the observance of these laws and conditions that man can reasonably hope to rise in the scale of being and accomplish the great object of his Creator. If he obeys them he will rise to noble manhood and reap all those blessings which pertain to such development. If he chooses to disregard them he may sink to the lowest depths of mental, moral, and physical imbecility; or he may attain to any degree of manly development between these wide extremes.

These laws apply alike to all mankind. There is no royal road by which the sovereign can attain to superior personal worth excepting that by which his most humble subject may reach the same goal. True nobility is the outgrowth of true manhood. Though society may vote "his mantle unto majesty," the man will nevertheless be just what he makes of himself.

"Pigmies are pigmies still, though perched on Alps,
And pyramids are pyramids in vales."

That ideal of nobility is only worthy of imitation which elevates the man above all fortuitous surroundings, alike those of gilded royalty, or the rough, uncouth exterior begotten by severe but honest toil, like that of Peter the Great, whose true nobility appeared more conspicuously when laboring as a common laborer in the shipyards of England, than when surrounded with all the regal grandeur of his throne; or like that of a Lincoln, who was nevertheless a man, whether splitting rails upon the farm, or conducting the affairs of a mighty nation.

Our ideal of true manhood should embrace the entire man in its conception. It should not elevate as our standard for imitation the man with weak physical powers and an undue development of brain, nor the physical giant with a meager brain, nor the man with that morbid moral development which characterizes the bigot; but that perfect ideal which points only to the full, symmetrical development of the mental, moral and physical powers. There is no law of God more clearly discernible to the human mind than that which requires earnest, persistent, intelligent labor, as the fundamental condition of such development. It is as essential to it as the food we eat or the air we breathe. Without bodily labor our physical powers become sluggish and unhealthy, which must of necessity be followed by both physical and mental imbecility. Without mental labor, those organs through which the mind communicates with the surrounding world fail to properly perform their functions.

This law of life pervades all animate nature, and its influence reaches in a modified form even to the inanimate creation. The stagnant pool begets putrefaction and disease. The ocean, even, is only kept pure by constant agitation. The air we breathe, were it to cease its motion, would be-

come charged with pestilence and death. Stagnation implies decay, while healthful, harmonious action is the life giving principle which bestows its blessings on every hand.

Superior mental or physical power results only from the mastery of difficult subjects, and the surmounting of great obstacles. Mere childish activity will never alone develop manhood. Activity like that of the fleeting butterfly, which sports from flower to flower, though it answers well the demands of childhood, will develop only childish powers. Neither will that aimless, listless exercise, so often engaged in by those whose time hangs heavy on their hands, lead to better results. That occupation which taxes only the physical powers will promote only physical development; and where the mind is only thus stimulated, failure must result from consequent loss of physical vitality. That labor is most beneficial which stimulates to the harmonious development of the entire man, by enlisting both his powers of mind and body in the earnest pursuit of worthy objects.

Man is endowed by his Creator with such powers of adaptation to circumstances, he can cultivate such habits and aspirations, and engage in such emulations, that even very intense labor, whether of the brain or hands, or both combined, may become to him a pleasure rather than a burden. It is such labor that most benefits him who engages in it, and it is only by such labor that perfect development can be obtained.

How noble the office of intelligent labor as viewed from this stand-point! It is the grand essential, not only to worldly success, but, through constant development, to happiness also. He only will be ashamed of it who has not been himself sufficiently elevated by it to comprehend its true nature and appreciate its importance.

When God pronounced a curse upon our first parents, and

said, "In the sweat of thy face shalt thou eat bread," he accompanied that curse with a blessing, by causing the very labor, which they and their posterity were from that time obliged to perform to procure their subsistence, to result in ennobling their being and increasing their capacity for enjoyment. We see this illustrated on an extensive scale in the history of nations. Where a bountiful nature yields spontaneously nearly all the necessaries of life, man will never attain a strong mental or physical development. Hence we look in vain through the history of the past for enlightened progressive nationalities within the limits of the tropics.

The primary causes of national progress or decline are climate, government, religion and fashions, yet these assume a national importance only by their influence upon its industries. If they stimulate the masses to noble pursuits, to hearty, generous, industrial emulations, individual and national progress will be the result. If their influence begets the opposite habits, ruin to human progress will result just in proportion to the extent and power of their influence. How important the subject of individual occupation. The man is of more consequence than his calling. We are prone in this fast age to allow the pecuniary features of our business to overshadow all other considerations; to overlook its legitimate tendencies and effects upon the mental, moral and physical welfare of him who engages in it.

It is true that one's industrial occupation does not necessarily *determine* the nature or degree of his individual development. The opportunities which it presents for improvement, drawn from other sources, are perhaps equally important. The miner and the Irishman upon the railroad, who toil only with the pickax and spade, cannot from the nature of the mployment be mentally elevated by it; yet they may

seek mental discipline outside of their calling. And so with a large share of the mechanical employments: they are not in themselves mentally or physically elevating, yet those who pursue them may seek both from other sources. The manifest want of opportunities for this, while in the pursuit of many callings, practically prohibits the attempt. And so the teacher, the student, the accountant, the artist, the author, and those engaged in many other employments, may have a sufficient variety and amount of mental labor to perform in connection with their business, and yet through their consequent want of opportunities to secure physical health by proper exercise, fail to possess that great essential to complete development.

He who pursues an ignoble calling, or engages in dishonest commercial enterprise, will not improve himself in those virtues which elevate human character. The slave-driver, the smuggler, the counterfeiter, he who purposely sells wares of any kind to be used for demoralizing purposes, or engages in any kindred pursuit which necessarily results in injury and wrong to his fellow men, though he may develop both mental and physical powers by his calling, will himself prove a moral failure.

In nearly every department of legitimate commerce strong temptations to wrong doing constantly present themselves, which too often result in the moral ruin of those who engage in it. Hence the corruption, depravity and vice which uniformly prevail in great commercial centers; which has rendered New York city to-day unfit for self government. And had it not been for the wholesome moral and political influence exerted upon it by the surrounding rural districts, which have furnished it with a large proportion of its men of brains and moral worth, we have reason to believe it would have ere this become a modern pan-

demonium, surpassing the ancient cities of the plain in its depravity.

He chooses well who selects that calling best calculated to elevate himself. And that vocation which in itself promotes in the highest degree the full and harmonious development of him who pursues it, and which presents the most favorable opportunities for reading and improvement in connection with it, and which is the farthest removed from all demoralizing influences, is evidently the most desirable and best adapted to the present wants of man.

What industrial pursuit more perfectly fulfills these conditions than the calling of the agriculturist, when properly conducted? As an intellectual pursuit it has no superior. To fully master the science of agriculture in all its departments demands a higher order of intellect than was ever yet possessed by man. It is rather the sum of many sciences; a field in which the man of weak intellectual powers may constantly learn if he will but apply himself, and where the intellectual giant may spend his three score years and ten in diligent study and practice, and then have failed to master half its mysteries.

The fact that a vast majority of the farmers of this or any other country gain a subsistence, and thousands of them a competency, with a very slight knowledge of their profession, does not disprove my position. We might as consistently maintain that the acquisition of medicine by the members of that profession is unnecessary, and therefore that that calling is not an intellectual pursuit, because medical quacks may gain a competency by their practice in many localities; and the same of the legal profession, because legal quacks thrive pecuniarily everywhere in the same manner. Yet a thorough knowledge of neither of these professions can be acquired without a manifest development of mental powers.

And as the science of agriculture, or rather those sciences which legitimately pertain to it, embrace a much wider range of knowledge than either of these professions, their acquisition must of necessity be attended by stronger mental development.

If practically the pursuit of agriculture has not this effect, it must be because of the truth of that statement of Baron Liebig, quoted at our last meeting, "That agriculture, though the oldest of the sciences, has made less progress than any other, because a smaller amount of intelligence has been put into its pursuit." Agricultural science, like all sciences, will only develop him who acquires it. Those demonstrated facts which collectively constitute the sum of all scientific knowledge are the same throughout the world, yet mankind for this reason are not alike enlightened by them.

If the professional acquirements of the agriculturists of this country were to be judged by the same rules that we apply to other professions, how many of us would escape the opprobrious epithet of quack? As a field for physical improvement it fulfills more perfectly the conditions required than almost any other calling. The farmer may degrade himself by his own stupidity, while in the pursuit of it, to the most abject physical slavery, and by a life of ceaseless drudgery blunt his powers of mental and moral perception, obliterate every spark of natural vivacity, and become wretched and unhappy. But it will not be the fault of his calling. He may do this in any other pursuit.

When intelligently conducted, agriculture presents a field for the most varied and healthful physical labor. By the introduction of an improved system, the use of labor saving machinery, and the provision of better conveniences in all its departments, its most unpleasant features have been or

may be removed, and its pursuit become a pleasure rather than a burden.

It brings man into direct and pleasing contact with nature, where he can breathe her pure air, and drink in health, vigor and vivacity of spirits if he will; where he may behold the footprints of his Creator on every hand, see in the beauty of every landscape the evidence of his intelligent design, and in the growth and structure of every flower and blade of grass the operation of those mysterious laws which his finite mind can never fully comprehend.

It is removed from the demoralizing influences of the city, from those fascinating attractions and distracting influences so destructive to those habits of persistent, industrious application without which business, and life even, will prove a failure.

Farm life, with its quiet retreat and seasons of comparative leisure, its long winter evenings and stormy days, furnishes opportunities for reading and intellectual improvement enjoyed by the members of few other callings. If the farmers' sons can have access to a good library, and will properly improve their opportunities, they may by a judicious course of reading acquire that knowledge of the world which will be of more practical value to them than that obtained by an ordinary collegiate course; of its people and their history, their governments, industries and peculiarities, the biographies of its illustrious men, of its geography and natural productions, its geology and meteorology, its botany and natural history, of anatomy and hygienic laws which govern his own health and that of his domestic animals. He can thus acquire a store of practical knowledge which will fit him for any position in life.

Yet with all these advantages the farmer may be, and often is, a dunce. He must determine for himself what his

standing among men shall be. The pursuit of agriculture is not a specific for the cure of idleness and stupidity. He may cultivate tastes and habits which will make the occupation of his winter evenings in the manner I have described a source of both profit and pleasure, and result in noble, manly development as surely as every effect is the result of its legitimate cause. If he habitually sleeps away those golden opportunities, cultivates habits of listless indolence and stolid apathy, he necessarily accepts the result of his choice, which will surely be a very low grade of intellectual development. If he habitually strolls to some neighboring store, tavern or grog-shop, to spend his leisure hours in idle gossip or to partake of a social glass, the results will be the same, only that he will add moral depravity to mental imbecility. By such a course he can never master his profession or be elevated by it. He will even complain of the low, menial nature of the very calling which he has not brains enough to understand. He will be so far beneath it that he will only comprehend its most unpleasant features. Its cares and toils will appear to his thoughtless fancy to assume gigantic proportions, and he will readily adopt that absurd and foolish notion, that intelligent labor is disgraceful; that the sinewy arm and the calloused hand necessarily indicate a plebian mind, while the soft white hand and a corresponding physical development betoken true gentility.

The farmer's son with such notions and habits, if, unfortunately for him, he is supplied by indulgent parents with pecuniary means, will soon lose his manhood, and sink to a level with those who rank personal attractions (and those even judged by a false standard) above substantial acquirements; broadcloth, silks and perfumery, above mental and moral worth. He will even fancy he can better his condition by leaving the farm and seeking some third rate clerk-

ship, where his delicate hands will never be soiled, and where the brain work required is only enough to measure silks, laces and calico, and utterly inadequate to develop brain power enough in him to rise to the head of his profession, or to a respectable mediocrity among men of mind. Such a youth, though he may dress in the finest of broadcloth, sport the most equisitely waxed moustache, flaunt his gay apparel and diamond rings, and be perfumed with the choicest of odors, will never possess true manhood.

Whence comes that idea that agriculture is a menial calling, an unworthy pursuit? And whence those absurd fashions which are corrupting the minds of many of our sons and daughters? Do they originate with our men of mind, with our pure and noble women, with the true nobility of our land? Never! but rather with the opposite extreme of society, from that self styled aristocracy, which though possessing pecuniary means is bankrupt in mind and moral worth. Labor disgraceful! By what means were those mighty minds developed which have honored and are now honoring our country and humanity? Were they the results of indolence and sloth, of modern fashion and frivolity? Like the modern dandy, were they the more the products of the tailor and the barber, than of the Creator? Do they come from the palaces of our millionaires, where habits of luxurious ease prevail, where generous industrial emulations are unknown, where stern necessity never incites to manly toil? Never! Do they come from our cities where grand display is the rule, and diligent application in youth the exception, where barbarous fashions and perverted tastes corrupt society, and the gay round of frivolous amusements occupies the time and attention of the young of all classes? Such conditions never develop such men.

The germs of our true nobility are most often found in some humble farm-house, or in some frontier cabin, both far removed from such influences; where some child of poverty has been subjected by stern necessity to those conditions which God has imposed for his development; where by honest toil and frugal diet the body, that early habitation of the soul, has been fitted to perform its part of a harmonious whole; where the free untrammeled soul beholds a boundless world before it, conscious that it must depend only upon its own resources for success in the race of life. This consciousness, in view of the mighty results to be attained, inspires in the youth that ambitious determination which is the great secret of success. With this inspiration he starts for a noble goal. His whole energies are enlisted, and whether toiling upon the farm or engaged in a more menial occupation, his success, humanly speaking, is certain. The very obstacles in his way become his greatest blessings, by the discipline which they afford. He attains a full, symmetrical development, and towers like an Abraham Lincoln above his fellows, the realization of a true ideal of manhood, who, like some giant oak which, though brawny and uncouth in trunk and limb it may be, is nevertheless an oak, the giant of the forest.

The conditions which developed a Lincoln were substantially the same that I have pointed out; the same by which all of that long list of noble spirits to which I have referred have been developed; and if there is a place on earth where above all others these conditions exist, where those divinely instituted laws of mental, moral and physical growth can most easily be obeyed, it is in the quiet rural home of the Vermont farmer. If his means are small, the probabilities of the ultimate success of his sons and daughters will be the greater. If they do not develop properly, it will not

be the fault of his calling, but the want of a proper pursuit of it, and his own failure to inspire in them that ambition which should lead them to properly improve these opportunities which it should afford them.

If he would accomplish their ruin, let him allow them to be taught that labor is disgraceful; that their delicate hands were never made for vulgar toil. Cultivate in them a false pride and spendthrift habits. Send his sons thus equipped to the city and his daughters to some fashionable city boarding school, where such precepts and habits will be enforced and confirmed by example, and he will surely "accomplish" in them "a stupendous failure;" yet he may be unable to trace their ruin to causes for which he himself is responsible. He may even wonder why his sons do not succeed in business; why it is that his daughters are pale, desponding and spiritless, while the domestic in his kitchen possesses the rosy cheeks of health, and exhibits an exuberance of life and vivacity. He may never know that practically an education founded upon such ideas and pursuits, in connection with such habits, will legitimately result in as complete a failure for all the noble purposes of life to those who are thus educated, as the sons and daughters of the Esquimaux and Hottentots. Yet "every effect is the result of a cause," and that system of education which is founded upon false ideas of perfection, which violates those laws of God only by the observance of which success is possible, must necessarily prove a failure, just in proportion to the imperfection of the ideal and the extent of such violations.

That ideal of womanhood which deprives woman of those nobler powers of mind which can alone fit her to properly fill her true sphere, which degrades her nearly to a level with the tinseled doll or gaudy butterfly, confines her from infancy within the narrow limits of the drawing room and

parlor, and excludes her from that free, unrestrained out-door exercise so necessary to health, is a dangerous one for the daughters of any class in society to adopt; and so also is that fashionable idea of female beauty which ignores a healthy, physical development, and substitutes deformity for natural symmetry, which, worse than Chinese barbarism, pinches the waist instead of the feet, which imitates the attitudes of the kangaroo and the humps of the dromedary, rather than that divine model which the great Architect himself has fashioned, and which immortal genius in all ages has adorned and proudly accepted as the standard of perfection in its works of art. Such senseless and perverted tastes are not the products of agricultural life.

The true ideal of womanhood is that only, which, when realized, results as nearly as possible in perfect mental, moral and physical development. Male and female education should be conducted upon the same great principles, and only varied in those details of knowledge which fit each for their peculiar sphere. Farm life may present to our daughters, as well as our sons, a field for development unsurpassed by any other calling, where they may lay the foundation of a mental and physical education, which when properly completed will fit them not only for usefulness but for the enjoyment of a degree of happiness unknown to the superficial devotees of fashion.

Let the farmer teach his children to honor their profession, and it will honor them,—to apply to it that combined mental and physical labor which will alone ennoble it and themselves also. It will thus elevate them to that position from which they will not be ashamed of their occupation, or to attribute to its honest labor that true manhood and womanhood which it will have developed in them.

# THE FARM AND THE COMMON SCHOOL.

A PAPER READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING, AT NEWPORT, AUGUST 7, 1872,

BY JONATHAN LAWRENCE, ESQ., OF PASSUMPSIC.

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One of the wise men of a former age, when asked what was most proper for boys to learn, replied: "What they should practise when they become men." According to the report of the Secretary of the State Board of Education for 1870, there were at that time 78,843 children between four and eighteen years of age in the State. It is safe to estimate that one half of the number are farmers' sons and daughters, and that the common school is their only means of education. If this is a correct statement, we have 39,421 farmers' sons and daughters who depend entirely on our common schools for their educational advantages. These schools, with all their errors, are the only avenue of learning open to nearly all who expect to obtain a livelihood by tilling the soil. True, some of our more wealthy farmers are giving their sons an academic or collegiate education, but it is not to qualify them for farmers, but to swell the already crowded professions.

Now if the wise man was correct,—if children should be taught in the common schools what they should practise in

after life, are the text-books now used in our common schools adapted to that end? Are the reading lessons in our authorized text-books calculated to inspire in the pupils a love of farm life? Does any portion of said lessons fix in their minds the beauty and usefulness, the necessity and importance of the pursuit? Who of us, who have lived half a century, and learned our A B C and our first reading lesson from Noah Webster's old spelling book, cannot, upon a moment's reflection, repeat verbatim the history of the two farmers, Thrifty and Unthrifty, contained therein? How many of the best farmers of the present age received their first agricultural aspirations, and resolved to become thrifty farmers, from the lessons read and re-read from that old spelling book? How many have tried to shun the path of the unthrifty, careless farmer, from the picture depicted in that same old book? Of what do the reading lessons of our authorized text-books treat? Anything, except subjects pertaining to the calling of the farmer. Why should not the youth in our schools, while learning to read, learn also how to grow flowers, how to raise fruit, how to plant, sow, reap, and mow, and the thousand useful and interesting subjects connected with agriculture and horticulture? Why should not our school books embrace simple treatises upon chemistry as applied to agriculture; botany, and every branch of science, as applied to the farm and garden? If "knowledge is power," and the want of it what keeps the farmer in the back ground, let us have a system of education adapted to the wants of the great mass of the youth of the State. Why, sir, with all due deference to the honorable Board of Education, and without intending to flatter any person present, I would much prefer that the *Vermont Farmer* should be one of the authorized text-books for our schools, rather than any book we now have in them. Yes,

sir, a judicious selection of articles from its weekly pages, read and explained in our common schools, would do more to excite an interest in and a love for rural life, and to banish the hankering of our youth for town and city life, than all the present *authorized* school books in Vermont. What more interesting and useful instruction for advanced pupils than the excellent papers read at the meetings of the State Board of Agriculture, Manufactures, and Mining? Is it not clearly the duty of said Board to prepare such reading matter, and, by cordial and systematic co-operation with the State Board of Education, to procure its ad ption into the future text-books of the State? Should a larger appropriation be necessary to enable the Board to carry out their present or prospective designs, their efficient labors therefor would justify the farmers of the State in instructing their representatives to vote all necessary funds for the full development of the important interests confided to their care.

Perhaps the importance I have attached to the subject will not be shared by those present. My aim is largely to provoke criticism and discussion. I have not the arrogance to advise, much less to dictate.

In the good time coming, as come it must in this progressive age, our school-house yards will become miniature farms, where fruits and flowers will blend in beautiful harmony, where our teachers will be expected and required to give instruction in the elementary branches of agriculture, horticulture, and floriculture. Then will young men and young women be as proud of their knowledge of these branches of education as they now are of music, drawing, and other ornamental branches, which should only occupy a secondary place in our system of education.

Mr. Wilder, of Charlotte, expressed his approval of Mr. Lawrence's paper. He had been a teacher, and he was sure that the wish of Mr. Lawrence that agricultural knowledge should be imparted in our primary schools was a very important idea. He thought it would interest the scholars and awaken the energies of their minds by giving them something practical to study, something that they could immediately apply in their daily life. He had himself endeavored to apply these principles to some extent, to interest scholars in the objects of nature around them, in the rocks and minerals of the neighborhood, the plants and trees, and various other matters of the same kind. It did good by arousing their intellects and stimulating them to observe and to learn by observation. It is impossible to get the old farmers to join in the march of improvement. We must begin early, in the district schools, to interest the young in the intelligent cultivation of the soil.

# THE GREAT WANT OF VERMONT FARMERS.

A PAPER READ AT THE MEETING OF THE VERMONT BOARD OF AGRICULTURE, HELD IN RANDOLPH.

BY J. P. FOSTER, ESQ., OF BARNET.

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*Mr. President and Gentlemen:*

Called from the labors of the farm to represent the Passumpsic Farmers' Club, at this meeting, I feel as the son of Jesse felt when he entered the lists as a champion of Israel. He had not proved the armor of Saul, but chose to lay it aside and take his sling. While I occupy a place to which I have not been educated, I will pray the learned Board to be patient and my brother farmers to exercise charity.

The Vermont farmers have, as a general rule, received a good common school education. Go into their habitations and you will see the signs of thrift and enterprise. Books, pamphlets and periodicals upon literature, politics and religion, are found upon their tables, and are read and studied with an interest unknown to many of the pursuits of life. Even the good house-wife (too often the slave of man) usually finds time amidst her crosses and trials to peruse her monthly magazine, to examine the fashion plates, to study the many useful receipts therein pertaining to her calling,

not found in her standard cooking manual, or weep over a tale that reminds her of hopes that have vanished with youth.

Yet with all this general intelligence which we have justly awarded to the farmers of Vermont, they are still sadly deficient. How many fully understand and are alive to the importance of saving and utilizing the manurial substances found upon their farms! How few of our farmers realize the great value of the vast deposits of muck, peat and other vegetable matter that has been accumulating upon their farms and in their neighborhood for centuries, as fertilizers, when properly applied! How many of our farmers are alive to the fact that the urine from their stock is of more value as plant food than the solid droppings! And yet how many farm buildings in former times were built (some still exist) with convenient reference to carrying the soluble portions of the manure into some adjoining stream, an entire loss to the farm! How few are aware of the great value of the leaves of the forest that each and every year collect in hollows and beside fences, and how little labor is needed to convey them to the stable, increasing the comforts of the stock and adding largely to the value of the manure heap. How many of our farmers fully comprehend the value of the fertilizing matter allowed to go to waste in and about our best regulated farm houses.

It is the common opinion among farmers that if they feed to their stock the coarse fodder and perhaps a portion of their grain, they ought to keep the fertility of their farms. It is allowed that each man, woman and child will consume on an average five bushels of grain for their bread per annum. At this estimation a family of six persons consumes thirty bushels of grain, which is the average of two acres of wheat in the country. Now add to this the vegetables, milk, butter, cheese, meat, &c., and how much less than an acre each of

tillage land does it require to furnish the subsistence of the inhabitants of the State? And yet how few of our farmers appreciate the waste or make any serious effort to prevent it.

Our English cousins adopt every practical method to utilize the contents of the privy. Here too often it becomes a nuisance, a source of sickening effluvia and disease, and yet with comparatively little labor in the judicious use of muck, the wash from the roadsides, or even dry earth, can this great waste be utilized and added to the manurial substance of the farm, largely increasing its products and profits. But after he has rigidly economised all the fertilizing properties upon his farm, he finds them inadequate to his wants, and lacking confidence in science, he asks "What shall I do to restore fertility to my soil, and enable me to obtain remunerative crops?"

Here let us look for a moment at English husbandry. It is said that they have doubled the products of their soil within the last fifty years. How have they done it? Agriculture was then so low that general alarm was felt throughout the Kingdom. Parliament took up the subject, science came to the rescue. The people were taught the value of bones, phosphates and ammonia as fertilizers, and the importance of high feed to give rich manure. Ever awake to her interests, the English at once subsidized the world. Bones were brought from the continent of Europe and America; ammonia and phosphate, in the form of guano, from the islands of the Pacific; and corn and oil meal for feed to increase their stock and enrich their manure heaps were purchased largely in our markets; and to-day the English farmers are as much better fed, educated, and as much wealthier, as their crops are larger than they were fifty years ago. And they now say to America, every bushel of your corn we feed plants so much of your rich prairie upon our denuded

soil. Would it not be well for the Green Mountain farmer to "make a note and turn down a leaf here."

Another great want of the Vermont farmers is some system of co-operation. Scattered and isolated among the hills and valleys, they are comparative strangers to each other. Although their interests are one, there is not that sympathy between them that ought to exist. All other trades and professions have their organizations to protect their mutual interests, but every effort of farmers thus far to co-operate for their mutual benefit has been stigmatized as a combination for evil. But we hope that a better day is coming. The meetings of the State Board will bring us together and scatter important information over the State. Farmer's Clubs are doing much to bring about sympathy of feeling and union of action in different portions of the community. And when we have a press agricultural in its character and spirit, which shall become the organ of the whole State, we shall feel that the day-star of our hopes has arisen. And now while looking at our present wants, we should not be unmindful of the coming generation who are soon to occupy our places. In our schools, the just pride of our State, do we find rudiments of agriculture as a study adopted? Has the State Board of Education done anything towards introducing into the best of our schools the simplest rudiments of an agricultural education? This want, in the humble opinion of your speaker, ought not to exist.

And now gentlemen of the Farmers' Club of Randolph, the Farmers' Club of Passumpsic sends greeting. We sympathize with you in efforts for the success of our common profession. We ask correspondence and co-operation. We promise you that we will put our shoulder to the wheel of progress, and give not back till success crowns our efforts.

We have great faith in our State Board, but it is yet weak, but by our united efforts it will become a tower of strength.

Prof. Collier spoke upon the topic of farm improvement by the economy of manures and the purchase of such as the farm does not adequately supply. He read to the meeting some statements of Prof. Cook, of the New Jersey Agricultural College, in regard to the improved agriculture of England. Attention was also called to the inferior quality of, and frequent frauds in commercial fertilizers, as well as the excessive price asked for those that are good. The importance of systematic education in the sciences directly related to agriculture was enforced.

Mr. Carter, of Randolph, wished to know if the mixture of ashes with other manures was injurious to them.

Prof. Collier explained the effect of caustic alkalis, ashes and lime, upon ammoniacal manures. These alkalis set the ammonia free, and it escapes.

Mr. Foster stated that this loss can be prevented in practice by the admixture of absorbents with the compost. Muck and earth were recommended for this purpose. Mr. F. inquired the actual cash value of good ashes as a fertilizer.

Prof. Collier replied that the question was somewhat complicated, owing to the different quality of ashes from various woods.

# THE VERMONT FARMER'S FUTURE.

A PAPER READ AT A MEETING OF THE STATE BOARD OF AGRICULTURE, AT ST. ALBANS, MARCH 6TH AND 7TH, 1872.

BY REV. G. F. WRIGHT, BAKERSFIELD.

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No class of men can long prosper at any business, or anywhere, without vigorous and constant use of their minds. The farmer, of all persons in the world, has before him the most difficult of tasks, to discern wherein the highest hope of future prosperity lies.

The young farmer has before him, in most cases, the great question of where he shall locate his farm. Shall he settle here in Vermont, or shall he go to the wheat-growing regions of the Northwest, or shall he go on to the vast plains of Nebraska and Kansas, or shall he turn his eyes to the still more congenial climate of the South? Shall he buy his farm in the more strictly rural districis, or shall he seek the higher priced lands that are situated near cities and larger villages? It is to be feared that the majority locate without having thought out definitely any plan of life, or having made any serious study of the elements of success in their several callings.

Though not a farmer by profession, I am glad to contribute to your discussions the result of a little thought upon

the elements that relate to the future prosperity or discouragement of Vermont farmers. I hope I may be able also to indicate some methods by which you may more fully improve your favorable circumstances, and obviate some of your apparent difficulties.

I. 1st. You need to bear in mind that the elements of nature are furnished you free. You have nothing to pay for them. You have only the trouble of making the powers of nature work for you. You have to pay only for the labor which other people perform in making the powers of nature work for you. 2d. The powers of nature are nowhere completely under man's control, but much more, he is under their control, and has much need to study how he shall adjust himself to their action.

II. The powers of nature with which the farmer is chiefly concerned may be comprehended under the heads of *Climate*, *Soil*, *Markets*, *Density of Population*, and *Spirit of the People*. Much under each one of these heads has a decisive bearing upon the degree of success that may attend any farmer's efforts. And, strange as it may seem, the climate and soil are affected by our individual action as directly and as largely as the density of population and the spirit of the people. The markets are as far from our control as anything else.

What these above mentioned elements are, what they are likely to be—what he can make them, and how he can adjust himself to them, are questions that ought to be thought through, before the farmer settles down to buy land or make improvements upon it in any locality. Let me assume that, either by necessity or choice, Vermont is to be the field of your labor in agriculture. What encouragement have you? What obstacles to encounter? What line of policy shall you pursue to overcome those obstacles and make the most of

your advantages? Let us consider in detail the things outside yourselves, that will naturally affect, for good or ill, your future as farmers here in Vermont.

## CLIMATE.

First in order comes the climate. There is a class of persons who are always complaining of their circumstances. There are some such in Vermont. The climate of our State is especially open to their attacks. The winters are long; the summers are short; there is mud in November, and there is slosh in March and April. But whatever may be said about the discomforts of our climate, it is certainly favorable to vigor of body and mind, and to long life. Our winters, though long, are not excessively cold, and are not subject to such extreme changes as occur on the plains of the West. There are some who cannot endure the rigors of our winters, but they are the exceptions. Cold weather is a tonic. With proper food and clothing and houses, we can protect ourselves against it much more successfully than we can against protracted and extreme heat. By mingling a due portion of fatty and starchy materials in our food, and by covering our bodies with the textures of wool and fur that are manufactured in such perfection, we may defy the extremest cold of our climate, and maintain an equable heat and a vigorous life within. Our houses, protected by confined spaces of air in the walls, may, with a moderate expense for fuel, be kept at a luxurious temperate heat during the coldest weather. As the wood disappears from our mountains we shall draw upon the coal mines of Pennsylvania for our fuel. Canal boats, laden with the coals of the Lehigh and Lackawana valleys, can with little expense unload their cargoes at the wharves of Vergennes, Burlington, St. Albans Bay, and Swanton. By our almost perfect sys-

tem of railroads this fuel can be laid down at a moderate expense, near every village in the State. We still have lumber in our own forests, with which warm houses and barns can be built at moderate expense. The Caughnawaga Canal will doubtless soon give us free access to the vast lumber regions of the Northwest. Meanwhile we will gradually build more substantial houses and barns of brick and stone, and be prepared for the time when lumber shall completely fail us.

In speaking of our winters we must not forget to mention the facility with which various kinds of work can be performed while sleighing lasts. All kinds of heavy team work are done to advantage in winter. Snow is better than mud. Two winters, while teaching school in Central Ohio, I waited long and anxiously for the roads to settle so that I could send a wagon five miles for a trunk. Twice I went that distance on horse back, and brought back my trunk before me, with the horse wallowing above her knees in the mud. I sighed for snow, and would have been glad of snow drifts even.

If, too, our springs are slow and halting, they are seasons in which we can reap rich harvests of that sweetest of luxuries,—maple sugar.

The shortness and coolness of our summers, it is true, interfere with the highest success in cultivating corn and fruit. But on the other hand they are favorable to health, to happiness, and to the production of the best milk and butter. Corn can be easily imported. Health and happiness, pure water, and temperate weather, can not be imported so easily. Furthermore the climate of Vermont summers, in connection with the magnificence and beauty of her scenery, attracts to us an increasing number of summer tour-

ists, who appreciate these delights, and seek to share them with us, and who in turn permit us to share with them their society, and some of their money.

I have hinted that the climate is somewhat under our control in other respects than as affected by warm buildings, and abundant clothing and fuel. Our mountains, by their elevation, and by the evaporation from the forests that still cover them, do much to equalize the annual rain-fall of the State, and to moderate the extreme temperatures of our seasons. Here is the point at which we can partially control the climate. A forest promotes evaporation. The branching roots prevent the too hasty running off of water in surface streams. The leaves provide a large evaporating surface. It is estimated that a good sized maple tree presents, in the combined upper and under sides of its leaves, an evaporating surface equal to an acre. An atmosphere thus saturated with moisture is more favorable to rains, and is a great protection against extremes of hot and cold. We owe it to ourselves and to our posterity to protect these forests, and to institute measures that shall cover again with forest much of the waste land already denuded.

You will be perhaps surprised to see how many interests are depending upon the protection of our forests. With their loss our rain-fall will be more capricious, our winters more rigorous, our streams more subject to floods, our springs more likely to fail, our crops more uncertain from drouths, our water power less regular and valuable, our mountain scenery less attractive.

These threatening evils, which are not peculiar to us, but are shared by the whole country, may be partially or wholly averted, by working on the public sentiment, to secure legislation protecting the forests that still remain, and encouraging the growth of new forests. Much has been done in

European countries in this direction, and much may be done by us to protect ourselves from future evils from this cause.

SOIL.

The soil of Vermont will bear comparison, in original elements of fertility, with that of any other portion of the country. There are alluvial plains at the West that now yield richer returns than our acres. But unscientific farming will soon bring them down to the productions of average land. Prof. Johnson says the soil of Vermont is inexhaustible. By this is meant that you have in it a basis that, with the improved method of cultivating and fertilizing, will yield the largest and most constant returns. When once you know how to preserve and utilize the fertilizing elements that accumulate about your houses and that waste so readily in nauseating and pestiferous gases, and when you learn how to judiciously spend a little money in purchasing and applying phosphates, your soil will become far more fertile than you have any hope of now. The productiveness of much of the soil of England has been more than doubled by these means during the last thirty years. There is no reason why it should not do so here. Let me indicate briefly some of the ways in which your labor and capital are badly economized in the attempted cultivation of too much land. The cost of plowing a field for a large crop is but a trifle more than it would be for a small crop. The cost of fencing a highly cultivated field is no more than for fencing one on which you do not realize one quarter the profit. The cost of securing a ton of hay that grows on a half acre is considerably less than that of getting the same amount from two acres. It is almost as hard to swing a scythe through the air as through heavy grass. Other items in the same direction will be noted in speaking of the advantages of density of population.

When we become sufficiently enlightened to our interests, much of the capital that is now invested in buying more land and in building new railroads at the West, will be spent in bringing the land we now have to a higher state of cultivation, and in making your own carriage roads more passable.

Dairy farming is the most favorable of all kinds for increasing the productions of the soil. Less of the mineral elements go off from the farm in butter and milk than in any other product. Increased productiveness of the soil renders possible a denser population, and with density of population come a variety of economies of which we will speak soon.

I have here but indicated a line of thought to which the farmers of the State should give their earnest attention, and which will, if you give sufficient attention to it, not disappoint you in its results. The farmer, more than most classes of men, can live and prosper only by a constant and vigorous use of his mind. His life needs to be a constant study of the laws of nature, and his energies need constantly to be on the stretch to so plan his work as to secure the highest economy. The most valuable properties of his manures go off in unseen forms, to infect the air with disagreeable odors; or hurry down the streams to feed the cod fish in the gulf of Newfoundland. Only by thought and careful planning can the farmer save and utilize these elements.

A large share of our strength is wasted in labor that does not profit. We make bad plans. We neglect to think of and attend to small things about our work, which neutralizes all our other work. Of what use is it to turn over four million pounds of soil, and swing a cradle over one acre of surface, when the elements of soil to produce a good crop are not there, and have not been there? Of what use is it

to have the best of cows, if they are not properly fed and cared for? Of what use is it to feed and care for cows, when there has been such carelessness in selecting and breeding them, that, on actual trial of them alone, they will scarcely make butter enough to pay for the salt they eat. There must be thought and calculation, as well as work, if you are successful on a farm.

### MARKETS.

But we leave this point to speak of our prospective markets. According to the census, the increase of population for the period between 1860 and 1870 was, in the Eastern and Middle States, as follows:

| | | | |
|---|---|---|---|
| Connecticut | 77,000 | Massachusetts | 225,000 |
| Rhode Island | 40,000 | Vermont | 15,000 |
| New York | 500,000 | New Jersey | 230,000 |
| Pennsylvania | 110,000 | Delaware | 12,000 |

Or, in round numbers, 1,200,000. The increase, during the same period, of the population of ten Western States was as follows:

| | | | |
|---|---|---|---|
| Ohio | 330,000 | Indiana | 300,000 |
| Illinois | 800,000 | Iowa | 600,000 |
| Kansas | 270,000 | Nebraska | 100,000 |
| Missouri | 530,000 | Minnesota | 260,000 |
| Wisconsin | 300,000 | Michigan | 400,000 |

In round numbers, 3,800,000. The increase in these ten Western States is thus three times that in the Eastern and Middle States.

These facts have an important significance to you as farmers. The increase of 1,200,000 at the East is composed wholly of a non-agricultural population. They are miners, manufacturers, merchants, capitalists, and professional men.

In their various callings they are doing a large share of the business of the whole country. The addition of 1,200,000 such persons to the population of the East has a great effect upon the nature and permanency of your future markets. They constitute a market at your doors, and create a prospective demand for many products of the soil which you have heretofore thought of little account. All these 1,200,000 laborers must be fed and clothed and housed. For their food and clothing and shelter they will pay somebody. It is the business of the farmer to inquire in what respects this large increase of markets may be made to enure to his benefit. As one of the elements in answering this question, it must be noted that the increase in the Western States has been mainly of the agricultural population. This increase of the agricultural population at the West is not of direct advantage to the individuals there. It has increased the competition in their markets. The few simple staples which they are forced to raise have been produced in such excess as to reduce prices to a ruinously low figure. Competition at the West has glutted the market with corn, wheat and pork. A friend writes me from western Iowa, that corn is rising. It has got up to eighteen cents per bushel, and pork will now somewhat more than pay for the powder it takes to shoot a hog !

It is a fallacy that many farmers entertain, that their occupation is the only productive one, and that it cannot be overdone. Whereas all lawful occupations are productive, and farming can be overdone as well as any other. Farmers prosper by exchanging, on favorable terms, their products for the products of other classes. If capital and labor are engaged in farming in excess of the natural demand, i. e., without a corresponding development of other industries, the agriculturalist is placed at a disadvantage in exchanging

his products. I apprehend that population is being pushed out into the grain growing region of the West too fast for its good. Our railroad policy at the West is pushing the development of the agricultural region faster than the growth of other industries demands. The significance of all this is, that it is useless for the Vermont farmer to compete with those of the West in raising those few staples of production that can be naturally raised West, and that will bear storing and transportation without risk of injury, and without too much expense. There is no doubt that the markets East can be supplied with wool, wheat, corn, pork, and beef from the West cheaper than we can supply them with these products here. It is also a question whether cheese and the poorer grades of butter may not be supplied from the West cheaper than we can supply them. But the great increase of population and of wealth at the East indicates a growing market for milk, for the first qualities of butter, and veal and mutton, and for the products of the garden, the bee-house, the poultry yard and the fish pond.

In the line of these markets the Vermont farmer has a substantial hold on the future. His soil, his climate, his abundance of pure water, his proximity to the markets of growing cities and villages, give him unrivaled facilities for success in these branches of industry, and incidentally he will have beef and coarse wool to sell, without losing all the profits in transportation. Also in economising his farm labor, and in seeking rotation of crops, he will easily raise a large portion of the grain he eats in his family and feeds to his stock.

The next twenty years are doubtless to witness a great increase in the markets for these products in our own state. The quarries of marble, slate, granite and soap-stone are to be developed on a scale surpassing our expectation. The

country has come to a stage when it is to build more substantially, and we have the materials accessible for the substantial buildings of a great and rich country. The ports of Lake Champlain are to hum with the busy industries of commerce and manufacture. Burlington is now the third lumber port of the country. What may not she, with Swanton and Vergennes, be, when communication is opened for ships of the largest size to the forests of Canada and Michigan, and to the grain depots of Duluth and Chicago? Nor do we yet see in imagination the growth to which St. Albans will attain, controlling as she does not only the most important of the railroads of New England, but those of northern New York and of the southern part of the Province of Quebec, and also prospectively to control the most important of the trans-continental railroad lines. The "Western Reserve" will not be long in spreading to the lake. Nor have I spoken of the vast amount of water power opened up to easy communication in the State by the Missisquoi and Lamoille Valley Railroad.

With all the prospect of growing markets, the farmers of Vermont have but to bide their time, and use their brains with their muscles, to be as they have been in the past, in a position of unrivaled stability and prosperity. With another 20,000 added to the manufacturing population, as will undoubtedly be the case in the next ten years, the farmers of Vermont need not fear that their occcupation will be taken away from them. But only those will prosper who use their minds in studying how to cater to the demands of this growing market and this changing state of things. Those who propose to farm without thought and without science had better go West and spend their strength in raising from the accumulated richness of Western plains, cheap corn and wheat and pork, to swell the profits of carriers and middle-men.

### COMPACTNESS OF POPULATION.

Before recurring to this subject again, consider the advantages that may be secured by encouraging more compactness of population in the rural districts. The main incentive that animates the farmers of our State has been, and I trust is to be, the desire of enjoying that complex thing known as civilization. He desires for himself society, education, contact with a large variety of his fellow beings. The enjoyment of these is the end for which he lives. A great obstacle to the enjoyment of these things is the distance that separates the population from one another. The farmer has too far to go to get to a good school, to a good church, or indeed to anywhere, where a large concourse of people assembles. Or if he secures these privileges nearer home, he pays extravagantly for them. If he has them he pays any way, for it costs a cent or two a mile to travel. In a sparsely settled country likewise, the store, the post office, the black smith's shop, the church, the doctor and the grave yard, are a long ways off. Besides the inconvenience, this occasions a great deal of cost in the wear and tear of travel, and in the construction and repairs of roads.

Now any use of your minds, by which you shall bring it about, that more people shall live and prosper, on a given territory, or nearer together, will enure to your benefit, as beings who love money, ease, and civilization. Whatever makes more labor profitable on less land, will make the economies of a denser population possible. This can be secured, and secured only by such use of your minds as shall introduce improved and more thorough modes of farming. Something also may be done in this direction, by imitating the French system of colonization, in laying out our farms in

oblong rectangles instead of squares, and in building our houses so far as possible on one street.

### SPIRIT OF THE PEOPLE.

The spirit of the people occupying a section of country is likewise one of the most important elements that promises fulfillment, or threatens blight to the hopes of him who settles in it. The larger part of our privileges can be secured only by intelligent co-operation. If either ignorance or selfishness interfere with the combinations that are natural and necessary in well ordered society, it is a great drawback on the prosperity of all. Educational, religious and musical privileges can be secured only by intelligent and unselfish co-operation. So is it with the enactment and faithful execution of good laws, and the building and repair of good roads. Intelligent co-operation is likewise essential to the best success of efforts to improve the live stock of a country. It is a calamity, greater than floods or drouths, to live in a community that has not intelligence or virtue enough to co-operate in securing these common ends. A public sentiment that is lax concerning the evils of intemperance and immorality, blights the fair prospects of every individual in it, by adding to the poor tax, by diminishing the efficiency and trustworthiness of laborers, by diminishing the force of the impulse to co-operation in public improvements, and by making it more expensive and difficult to start one's family on a hopeful career of prosperity. A high degree of intelligence and self control in people is necessary to secure that legislation and individual action which shall preserve the forests on the waste lands of the State. And yet the future of our agricultural and manufacturing interests no doubt depends very greatly upon our success in preserving at least the present proportions of timbered lands in the State.

CONCLUSION.

In conclusion let me sum up some of the duties which the future demands of us.

1. Our manual labor must be seconded by a still larger admixture of intellectual labor. The high degree of intelligence and self control existing among the farmers of Vermont, heretofore coupled with a naturally good soil, has made her acres more productive than those of any other State. In 1869, Vermont raised, with two or three exceptions, more bushels to the acre of wheat, rye, oats, potatoes and corn than any other State in the Union. This has been effected, not so much by superiority of soil and climate, as by superiority of industry and intelligence, acting under the spur of higher prices, and under the direction of a far sighted morality. The specific directions in which we can profitably use our minds to improve our condition have been already more than intimated. We should favor all educational institutions that broaden the grasp and sharpen the insight of the promising minds of our youth. We should give a helping hand to all institutions tending to secure among our citizens a high degree of morality and of religion. Professional men, such as merchants, doctors, lawyers, ministers and teachers, do more for society in greasing the machinery than most give them credit for. Have away with all this jealousy of other professions and occupations than your own.

2. We should aim to secure such a public sentiment and such legislation as shall protect our forests and as shall encourage manufacturing in the State.

3. We should encourage local agricultural societies, which shall gather and disseminate the knowledge that is necessary for the highest success, and which shall serve as a basis for co-operation in all matters of mutual interest. These local

societies should, in co-operation and communication with the State Agricultural Society and College, make the study of the soil, and of the fertilizers and grasses, and live stock best adapted to it, matters of systematic experiment. We should not cease these efforts till we make the most of the natural elements of our soil; till we save and return to it all our home made fertilizers, and can use commercial fertilizers with economy and certainty; till we have the best variety of grasses growing most luxuriantly in the places best adapted to them; and till we have the hardiest, sleekest, and most profitable herd of cattle grazing on our hillsides or lounging about the stalls where we feed them. Vermont sheep and Vermont horses have been the admiration of the world. So we need to make Vermont butter, and milk, and mutton, and trout, and honey, the desire of epicures the world over. We need also to be careful to entertain with due hospitality and consideration the summer tourists that visit us, and not drive them off by exorbitant charges.

These things done and no brighter future dawns upon any class of people in the world than that which dawns upon the Vermont farmers.

# THE NECESSITY OF SUCCESS IN "BOOK FARMING."

A PAPER READ BEFORE THE STATE BOARD OF AGRICULTURE, AT MIDDLEBURY,

BY Z. E. JAMESON, MEMBER OF THE BOARD.

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When, in 1867, Col. Geo. E. Waring, of Newport, R. I., commenced the improvement of "Ogden Farm," he was asked, "what kind of a farmer are you going to be?" he answered, "I am going to be a book farmer." He also says "I am told that there are men who think the only things worth knowing are the things that they themselves happen to know; but I do not believe that these can ever produce their best results without the aid of a knowledge that can only come from books."

At this time there are many young men commencing farming that have been acquiring education at academies, or acquiring property by work in manufacturing establishments, or mercantile business; there are also middle-aged men, who have, perhaps, been successful in gaining property in manufacturing, practicing law, or medicine, or other pursuits, and have decided, that real estate is safe and desirable property to own, and the cultivation of the soil an occupation full of pleasures, and wonderfully remunerative. Many of these beginners have a favorite theory to exemplify,

by which startling results are to be attained, and this theory has often been worked up from reading books and agricultural papers. One believes that the secret of success is a nice set of buildings, especially a barn, as most farmers that are good whole-souled fellows have large, nice barns. So the barn is built, but not always filled. Some value their woodland, and desire to preserve it and plant more; oftener they become lumbermen, and strip their hillsides of their beautiful covering, and in cord-wood and logs do a heavy and unprofitable business, and call it farming. Others have an affection for horses. Books upon breeding, training and diseases are often consulted, and the *Spirit of the Times* is their favorite reading. The farm is a good base of operations in the horse line. Others have an idea that if they can have blooded stock they are all right, and they estimate their income upon the probable increase of their stock, which is to be sold at prices as high or higher than they pay. Many times this estimate of blooded stock is disastrous. In 1865, I visited flocks of sheep, and my attention was directed to some worth a thousand dollars each, warranted straight Hammond sheep. Several young farmers, educated and intelligent men, owned flocks of these sheep, and I was carefully informed in regard to the importance of beginning right. Certain sheep were pointed out, of compact form, beautiful, even fleece of long, fine staple, perfectly satisfactory in weight, yet the sheep were not fashionable, and therefore were not a tenth part as valuable to sell, although of equal value to keep. I have since learned that it is as desirable to end right as to begin right.

Some, who have bought Short Horn cattle and found a defective pedigree, or a black-nosed animal, ruled them out of the company of reliable, successful breeders. So the animals, bought at blood prices, were sold at beef prices, and in-

stead of the young farmer "going up like a rocket," he came down like a stick. So of all other breeds of cattle, sheep or swine. The new beginner, whether he is a retired business man or a young farmer, is liable to become the purchaser of second rate blood animals, the breeding of which leads to loss and discouragement, and this ill fortune becomes a by-word in the mouths of those successful farmers who buy no new potatoes, oats, or other grain, until they can exchange even a like quantity of their own produce, and who, if they can by *hook* or crook get possession of a half blooded animal, will declare it is far better than any full blooded one—"kinder tuffer, and don't need so much nussin'."

These successful farmers have in their minds a list of men who, with education or money, or both, have attempted farming, and gradually exhausted their means and courage, and from this list they choose illustrations in argument against an investment in improved stock, grain, or culture. There is no class of men who should more earnestly seek success than the well educated farmer, who acknowledges the value of books and takes good agricultural papers. He should succeed, in order to overthrow the impression that ignorance is better than knowledge, and muscle better than brains, even in this laborious calling. He should succeed, on account of the comforts that success brings,—a good home, equipage, stock, and farm, all made good and kept so by his management and care.

There are several things in the way of the success of one whose capital is mostly in brains. He will be put on various committees, in care of churches, academies, &c., to raise the preacher's salary, to collect money for missions, for Sunday ool libraries, and for home institutions of various k' . He is entreated to make himself useful as a Good

Templar, a Mason, a Patron of Husbandry, School Superintendent, and of course he must have town office, serve as District Clerk, and run the Farmers' Club. He should attend political conventions, caucuses and elections. He must be delegate to various meetings and conventions, where he will be entertained gratuitously, or only out a day or two in time and a few dollars in money. Then he is the marked prey of every map peddler, book agent, and patent right vender. They each declare his influence must be given to introduce this map, book, mouse-trap, churn, beehive, or other device, by which the agent wishes to defraud the public, and he must entertain all itinerant searchers for knowledge from all parts of the earth, and the same old farmers, who lend him money at ten per cent. on good security, are often the most ready to put all these unprofitable offices, honors and emoluments upon the educated farmer, and then if his cattle are neglected, or his wood-pile small, or weeds trespass upon the crops, or his notes remain due, they are the severest critics and most troublesome creditors; and when, at last, the auction sale winds up the farming career of this useful man, these same shrewd farmers are eagerly on the watch to get his blooded stock at a bargain. The educated farmer goes West, where there are young men enough to share the duties of public life, and where he can govern his living by his means, and his means by his living.

I would now call attention to this truth: it is the duty of the educated man, who commences farming, to do his best to become a successful farmer, as a book farmer, because the success of some who call themselves successful cannot be repeated continually by any possible process. The earth, like a cat, may have nine lives, but those lives will certainly *all* become extinct with that remarkably successful treatment

that makes a desert in one generation, from good land, in all the Atlantic States and portions of the West.

Put aside all this extra gratuitous work, and extra expense and care, for only those things that contribute to the welfare of yourself and family. Consult your books and papers, and practise approved methods. Take from the public its most formidable argument against education, by proving that it does not hinder the success or happiness of a farmer.

One of the first requisites in commencing any enterprise is *practical knowledge.* This should be gained in part by working as an apprentice, so that the loss by bad management may fall upon the instructor. One of our natural and inalienable rights is "*a knowledge that shall enable us to get a living by our labor among the people where our childhood has been passed.*" If we were Esquimaux, we could rightfully claim the knowledge necessary to build a rude habitation, catch and stew the seal and walrus, fish, or polar bear. If we were Digger Indians, all we could rightfully claim would be the knowledge that our parents possessed, the proper ways to roast snakes, grasshoppers, fish, and dead horse. On the plains of Brazil or parts of the western world, the use of the lasso and the care of a mustang should be familiar to us. If our boyhood is passed on a Vermont farm, we are cheated of our birthright if we are not taught to train a team, till the soil, apply manure, sow the seed, harvest the crop, shear the sheep, or put the income from the cows in a good merchantable form. And further, as the farmer is necessarily a dealer, we should be taught to buy, sell, and swap, with that shrewdness that successful Vermonters always show. The losses incident to obtaining this knowledge should be borne by our parents or guardians, and

we pay the debt by as freely educating our children in the future.

2d. Theoretical knowledge is necessary. For this we must depend largely upon books and papers. We can individually originate a theory, or tell why clover is better than meadow grass, why rennet coagulates milk, or why butter spoils in the tub, or why seed corn must be dried before freezing and without heating, and why we cut grass or grain at a certain stage of ripeness; but we cannot, unaided by science, and depending upon our own experience, find out in a lifetime what a book would tell us in an evening.

3d. Executive ability leads to success when combined with knowledge. We know how to do, better than we do. We mean by this third quality that *all farm operations must be done seasonably*. No chemical analysis of soil or manure will take the place of timely planting, proper weeding, and careful harvesting. Executive ability leads a man to sell his surplus at the right time, and for cash, to buy where he can buy cheapest, and take advantage of every circumstance that is in his favor. It is another name for smartness.

4th. God's providential care must ever be an element of success. When a man has, to all appearance, done his best, his plans are well laid, and the fulfillment seems sure, then the hand of disease may rest upon him, and he ceases from his labor. Fire, floods, and storms may be destructive to life and property; fortunate is the farmer who, in the day of trouble, finds friends to lean upon, who will not chide him for his attempts at improvement, or censure his book farming, but will heartily aid in restoring his broken fortunes.

Now I would call your attention to the farmer's stock in

business, which he should preserve unimpaired if not increase.

1st. Fertility of the soil. Many men have called themselves successful farmers who have accumulated money and rendered the farm unproductive. In the New England States, and in the South, instances of this kind are common; barren, deserted farms are again being covered with forests, and where trees now are, can be seen the rows and hills of the last corn crop. If all the money accumulated must be spent in restoring the strength of the soil, the farmer has not achieved a success to be imitated, and if he has exhausted the soil and only lived, he has lived on his children's money; they may thank God that the world is wide, and there are other fertile lands to till, as their father has eaten up one farm.

2. Health, vigor, and honesty of manhood must be kept on hand. If, with excessive labor, we wear ourselves out, and come to a premature, rheumatic old age, we make somewhat of a failure; and if by sharp, dishonest practices, half-penny meannesses, or extensive swindles, we gain money, then it is not by farming that we achieve success.

3d. The happiness of a wife and family are stock in trade. If there is not a reasonable amount of enjoyment in life on the farm, the wife will feel the deprivation. Life-corroding care, constant work, monotonous thoughts, bring the housewife to a state where she falls an easy prey to the hand of disease; but we hope in most cases, and in the present state of society, happiness is pretty evenly distributed. In regard to the children in the farmer's family it is certain that in many cases they are early taught that they must leave home before or at their majority. The question is often discussed, What shall the children do? They are aided in their choice, by being educated and advised with

the thought of absence from home ever before them. The girls teach school, work in mills, become clerks, or marry. To the boys, a score of paths are before them for their choice. But I can hardly style that farming successful that does not seem attractive to these boys, that should be acquainted with all its pleasures and sources of enjoyment and income. A scattered family that hate the farm, a deserted home, an aged father and mother waiting, alone or with hired help, for the summons to come, to take them to their final home, are sorrowfully suggestive.

4th. The reputation of the business is stock in trade, and in nearly all enterprises by which men live, there are certain elements that are not seen that have a value. The doctor or lawyer sells his business; the manufacturer, merchant, or mechanic, if very successful, can value the good will of their trade as something above the value of their taxable property; a butcher, in a country village, sold his route for $500—he claimed he could make it more profitable than any farm; the milk producers make public the act, that a route that consumes 40 or 50 cans of milk a day is sold for about $3,000; what really is sold in this case is the chance to make money by following this business.

This illustrates what I mean by the reputation of farming. In New England, there are many farms that can be bought for less than the buildings would cost if built at this time, and the majority of farms are for sale, and the impression in regard to farming is that it *don't pay*. The vacant places are not eagerly bought at a large advance; the chance for making money is not remarkably brilliant.

Now let those who expect book farmers to fail, consider their own situation, the fertility of the soil, the state of *their* family, the reputation of *their* business, and *their* own reputation for honesty, friendship to the neighbors, generosity

toward all enterprises that are worthy, and cast the ballance: *how great has been your success?* We wish the beginners in this honorable and remunerative calling to show their success, 1st, by the productiveness of the soil, in judiciously chosen crops, and the thrifty cattle, safe, tidy, and convenient buildings and fences; 2d, by the enjoyment, satisfaction, and pride he and his family take in his pursuit or occupation; 3d, by gaining the esteem and respect of the public, and others of the craft. Generals, lawyers, doctors, editors, and divines have become famous, and received position, reverence, and respect. In days to come, successful farmers will become well known, and honored by all around them, and by tillers of the soil in other lands. Abundance, enjoyment, and honor should be the object of the intelligent farmer of to-day; but do not reverse the order of this reward, and seek honor first; it will destroy your *enjoyment*, and prevent the *abundance*. Be practical. Be sure of an income, then do good and serve the public. At present, all the farmers in the country are influenced by the agricultural reading that occupies a few columns in most of the newspapers; and there is more need of our becoming book farmers, because those who took the land in its natural fertility and run it out, cannot teach us how to restore it again to its original strength. The chemist in his laboratory can aid us. We know that hay, grain, beef, mutton, wool, pork, etc., have been carried away and the land is poor. The things that must be applied are called potash, lime, phosphates, etc., sometimes common sense and elbow grease, and the land is restored. Let us boldly place upon our banner these words, BOOK FARMER, and see to it that no blundering failures in practice bring reproaches upon our theory.

Following the paper was a rather desultory discussion on the topic treated, and also on the advantages of Farmers' Clubs.

Prof. Collier said that if the Board presented no other claim for its continued existence than that it fostered and encouraged Farmers' Clubs, it would have done enough to entitle itself to live. Looking over some old agricultural works that had been brought to the hall by Mr. Chapman and which lay before him, he could see that not ten per cent. of the farmers of to-day knew, in regard to farming, what some farmers knew fifty years ago. Farmers live such isolated lives that knowledge does not spread among them as it does in other avocations. They need to get together and exchange their stores of observation and experience, and the winter evenings were the time, and the Farmers' Club the place, where it should be done. There they can mentally plow, plant and hoe, producing a winter's crop of as much value as that of summer. That is the time to plan for the future and review the operations of the past. How many do this, or can tell anything about the cost or profit of their crops?

Dr. Hoskins thought it very necessary that book farmers should succeed, as farmers are generally very jealous of book farmers, and pleased when they failed, attributing their failure to book farming, rather than to their capacity. Few seem to be aware of the fact that book farming is nothing but using the knowledge and theories of others. Many farmers would do this, but would shy as bad as a skittish horse if the same flew across their track in a printed form. He would advise book farmers to tend to their business, and not accept too many ornamental offices, simply because they

were better qualified to fill them than those who had less information.

Mr. F. D. Douglass of Whiting, spoke impressively of the condition, hopes and prospects of the Vermont farmer. Man, he said, was what his surroundings make him. Place him in Greenland, he will become an Esquimaux.

In the arctic or torrid zone his capabilities were not developed, because in the first nature was too hard for him to conquer, while in the last she was too bountiful, and left him no stimulus for exertion. But in the temperate zone, where his energies are taxed, we see better results. But even here man is still, to a great extent, the product of his own surroundings. Place a boy with a bad Vermont farmer, and he will grow up a bad farmer, unless he has enough innate force of character to leave in disgust. The obstacles that surround us are not insurmountable, but just sufficient to draw out and develop our best qualities. If agriculture was pursued among us as it should be, we should have a development of manhood seen nowhere else. But we have not yet such results, although we have some progress. The great mass of farmers know only the first elements of agriculture. We must learn to unite profit with beauty. Where there is really good farming you will see neatness in buildings, fences and all the surroundings of the homestead, and *vice versa*,—not extravagance, but sensible, thrifty farming.

Have we enlisted enough of brain work to make us progress as we should? The thrifty farmer will exhibit his thrift by his surroundings, and as you pass his place, you would take his note of hand without investigation, as you would refuse that of the shiftless farmer without an indorser. We should become better informed, and give evidence that we had improved the condition of our farms.

Mr. Wright thought we had improved,—Cornwall had learned to raise onions successfully.

Prof. Collier. If Vermont had improved as she should, not only Cornwall would know how to raise onions, but all the towns in the State.

Mr. Jameson would advocate small farms, as there was more ability to improve. The counsels of the old and the strength of the young should go together.

He thought old farmers were not disposed to teach the young ones what they knew; they are too reticent; so each generation has to spend most of its life in learning from experience what they should have been taught in the beginning.

Mr. Wright thought there was really some improvement going on, and felt that farmers need encouragement. Farming is progressing, but we have been cultivating too much land for our capital.

Prof. Collier thought there had been great improvements in farming in some cases, but they were not so general as they ought to be.

We must take more time to rest, and improve our minds. Our evenings should be used to gain information. We can learn as much in one evening, as by the mere experience of a life time.

Prof. Seely suggested there was as great lack of success in farmers changing to other employments, as from persons of other professions turning to agriculture.

Mr. Jameson contended that the farmer should stick to his farm, in order to succeed. Having acquired a competence he may turn his attention to other fields, but not before. He

said that all trades and professions were recruited from the farm.

Prof. Seely replied that this is true, but in such cases the successful ones at least began early in life and with a considerable amount of training for the work they undertook. What he referred to more particularly was farmers getting tired of the monotony and small profits of the farm, selling out and attempting mercantile speculations. Usually this is followed by failure. The training of the farm unfits them for the sharp competition of their new employment. Prof. S. mentioned recent instances within his own knowledge of men with good farms who had sold out, gone into trade, and become bankrupt.

Prof. Collier said that book farming must be a success, or all farming is a failure. All there is in any successful farming that makes it successful is that very knowledge which, when printed, goes by the name of book farming. Book farming must of a necessity be a success. There are no successful farmers except book farmers, for to be successful they must follow the same rules laid down in books, no matter whether they read them themselves, or found them out by the harder method of experience. Mr. Lane's success in pear culture, as well as his success in improving the sugar beet, of which we have all heard, was simply the result of book farming, the application of scientific knowledge to the work in hand. All rely upon science; who would trust himself on a train run by an engineer who boasted that he knew nothing of "book engineering?"

Mr. Wheelock of Barre, spoke of the general unsuccess of men in mercantile pursuits compared with the security of agricultural life. We should use more influences to keep

the young people on the farm. It is a good thing that farming, while safe, is not excessively profitable. If it were so, there would be a rush to obtain all the good land, and it would be monopolized in the hands of rich men. If farming was as profitable as the mercantile or manufacturing business, farms would be so dear that no young man could buy one. Farming is sure, and if not so remunerative as some other callings, was desirable because sure.

Prof. Seely said that a man entering any pursuit needed education in his business. No man could expect success in following a business of which he knew nothing.

Mr. J. N. Perrin said that book farming was simply another name for intelligent farming, which he thought must pay if any did.

Mr. Hersey spoke of the evil of relying upon books and papers to the exclusion of common sense. He instanced the directions in some papers for putting in clover in a simply wilted state, and said it never did and never could succeed, and that no man of sense and reflection would ever make the trial.

Mr. E. W. Bisbee, of Moretown, made a raid on the book farmers, and instanced Horace Greeley as a fair sample. Was not disposed to sneer at science as applied to agriculture, but thought it difficult to follow profitably all the rules laid down in agricultural books.

Dr. Hoskins said that farming was not Mr. Greeley's business, but his recreation, and he did not expect to make money out of it. But who could doubt that if Horace had put the energy, the talents, the perseverance, pluck and common sense that he had put into the *Tribune*, and which had made it the most influential newspaper in America, into farming

that he would have become one of the first and most successful farmers of the time, as he was now one of the first editors.

E. W. Bisbee said that we did not farm as well as we knew how. We ought to put more enterprise and intelligence into our farming.

Mr. Josiah Holden, of Waitsfield, agreed substantially with Mr. Bisbee. He thought more common sense should be used in farming.

Dr. Hoskins said that no one could buy a book and make himself a chemist, nor could any one buy a book and make himself a farmer. It needed book knowledge *and* experience. Together they were sure to win.

Dr. J. S. Spaulding, of Barre, thought we might avail ourselves of the experience of others, as well as to find out everything ourselves by experience.

Prof. Collier agreed with those who demand common sense in addition to science on the farm. Some who can't, or at least who don't, read at all, are yet book farmers in reality; that is, they succeed by the use of means that were thought out, rather than worked out. Every man who uses any improved agricultural implements or machines is a book farmer in spite of himself; and so of him who plasters, limes, or marls his land, cultivates green crops, practices rotation or fallowing.

Dr. Spaulding illustrated the absurdity of the opposition to book farming by speaking of the difficulty with which a man could make soap without instruction. He would fail time after time, without knowing why; but a book, or an experienced neighbor, which is the same thing in reality,

could show him in an hour how to do it, and to do it successfully ever after. He would then be "book soap maker," and make "book soap."

Mr. Bisbee said that really he was not so much opposed to book farming, but his neighbors were continually after him on the subject, and he thought he would draw out from the wise men here present the arguments in defense of book farming, so that he might have them ready for his own use in future.

# HOW TO MAKE FARM LIFE PLEASANT.

A PAPER READ BEFORE THE VERMONT BOARD OF AGRICULTURE, &C., AT ITS MEETING IN MIDDLEBURY,

BY E. R. TOWLE, ESQ., OF WEST BERKSHIRE.

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To be truly successful in farming, as well as in all other occupations, it is quite essential that it be rendered, so far as possible, attractive and pleasant. There are many ways by which this desirable end is to be attained, to a few of which we now respectfully invite your attention.

And first in the list, permit us to place a genuine love for the occupation. Farm life, it may be presumed, will present few attractions to the individual who engages in it from necessity, but with no real delight; whose whole heart and soul are somewhere else. He may, indeed, go through with the entire routine of labor and toil, from one year's end to another, may form into active exercise and use the resources of a well-stored and cultivated mind, even securing results that in other instances might be considered most satisfactory, yet if there is no pleasure in the occupation, if such a life is distasteful, and its labors irksome, no pecuniary results, however flattering, can compensate for this want of adaptation—this real, enthusiastic love of a man for his occupation. Such an individual had better engage in some other occupation.

But we cannot well conceive of a man being very successful in farming with no kind of love for his occupation. Such instances, we think, are not often met with. If a farmer is satisfied with his calling, takes delight in following it, has ambition to do well, a mind to plan, and a will to execute, we may reasonably look for and expect results that will correspond with these characteristics.

And this love for his occupation will manifest itself in many ways; it will be so plainly apparent that the passer-by, although a stranger, cannot fail to notice and appreciate it. The house and its surroundings will tell of this love; it will be not merely a place in which to stay, but a *home*, around which will cluster all the hallowed associations of life, the center from which will emanate those characteristics of mind and qualities of soul that will be the master setting of progress and improvement, visible in all directions about the premises and farm. This love of the farmer for his occupation, if faithfully and practically carried out in works, cannot fail of making farm life attractive and pleasant, and we may also add, successful.

Closely united with a love for agricultural pursuits, the farmer must certainly possess faith in his calling. He must have just such a faith as, with the other necessary qualities of mind and heart, will render him truly successful, and his life pleasant. This faith is comprehensive. It will make him to foresee certain results, the effect of causes, with a good degree of certainty; it is truly the substance of things hoped for, and which may reasonably be attained. Perhaps we can make this plainer by illustration. A farmer has a piece of wet ground; it produces nothing of value, yet the soil abounds with all the elements of fertility necessary to produce abundant crops, but these are rendered inactive by the superabundance of water, and the land in this

state is practically worthless. He knows from observation and the teachings of common sense, if not by personal experience, that if this land is properly drained, the naturo of the soil will undergo a change, the superabundant waters will pass off, and with them will disappear those poisonous exhalations and unpleasant features that render the field something to be avoided and not desired. He beholds it in its present state, not a thing of joy nor beauty. He looks ahead to the time when there will be a change, the result of simple causes—drainage and proper cultivation—and what does he then see? A field smooth and dry, bearing upon its surface abundant crops, such as to make glad the heart of any one having eyes to see and a soul to appreciate, the beautiful creations that even man may undertake, and carry on to a reasonable degree of perfectness.

But it will take money, time and labor—hard labor, to accomplish all this. There must be a mind to plan and a will to execute, but will not the end justify the means necessary to bring about this desirable state of things? Yes, at least the farmer thinks so, as he rolls up his sleeves and commences the task. He has a love for his calling, a love that manifests itself in just such efforts as this, the transforming of barren wastes and unsightly sloughs into fruitful fields, a faith that nerves his arm with vigor, and enables him to grasp at and accomplish what some in their indolence and short-sightedness would consider impossible results.

Farmer friends, we want just such a love, just such faith as this, that will stimulate us continually to works of progress and improvement. We want these essential qualities united, work, energy, decision of mind and purpose, courage and ambition to do well and to excel, to render farm life what it is intended it should be, pleasant and profitable.

With these desirable qualities the farmer will work wonders upon his domain. There will be smooth meadows, unincumbered with roots, stumps, and stones. There will be substantial fences, rendering a hedge of briars and bushes on each side unnecessary. We shall see buildings adapted to the purposes of the farm. These will be well arranged, commodious and well cared for. Economy in time and labor will be studiously sought after and secured, as well as the comfort and health of the stock occupying them. These arrangements will be complete, and not only these, with which the farmer himself is more immediately connected in his daily labor, but also those which more nearly concern his wife and family. As before mentioned, the house will not be merely a place to stay in, but a genuine farmer's home, such as one often sees scattered here and there among the hills and valleys of Vermont.

The house where the farmer's wife is supposed to preside, where the greater part of her life is passed, the scene of her labors, of her trials and her triumphs, should be constructed with especial reference to her convenience and tasks. Full well we know that with the best of arrangements to facilitate the labors of the farmer's household, there is much of toil, much of care that must be endured; therefore if we would render farm life attractive, due regard must be had to this most important matter.

Here also is where farmers' sons and daughters receive their first impressions of life, and how essential that these impressions be of the right character. They will soon learn to make comparisons, and if in so doing they find that their homes and condition do not correspond in any wise with those of their neighbors, or perhaps of persons of other occupations, it is quite likely a dislike for farm life will be created, especially among the boys, as is too often the case at

the present day, and home will not present sufficient attractions to prevent them from leaving it, perhaps forever. Farmers will do well to give this part of our subject a careful and thorough consideration; its importance demands this. If farmers' homes and farm life were made more what they should be, pleasant, inviting and attractive, it is pretty evident there would be less of disaffection among the boys, and more of willingness to become farmers' wives among the girls.

The instances are far too common where a farmer has reared quite a number of boys, and finds in his old age that not one is willing to remain on the farm, and that in consequence the ancestral home, however dear to the father's heart, must fall into other hands. It is not to be supposed that *all* of our farmer's boys will follow the paternal occupation; this is expecting too much; yet we would have it rendered so pleasant and inviting that none would hesitate to engage in it on this account, at least. This is one great incentive—perhaps the greatest—that should induce farmers to use every possible endeavor to interest their boys—we speak of boys more particularly now, but the same rule, properly followed out, will apply to the girls—in the occupation with which they are so intimately connected, from earliest recollections, or childhood. If an interest is created for agricultural pursuits a very important point is gained. This interest should be watched and encouraged in its development, not checked or thwarted as of no account. This is an age of progress and improvement; old habits and customs are passing away; new ones take their place. Henceforth farming is not to be conducted by physical force alone. The inventive mind comes to the aid of the toiling hands, and there is a respite from the dull monotony and routine of labor that

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is but a little elevated above that of the beasts that do our bidding. The farmer who recognizes this new order of things, acknowledges that it is right in theory and in practice, has taken a long step in the right direction. He will no longer make a mere machine of himself, his wife or his children, for the accomplishment of so much manual labor, with no ambition, no desire, reaching above, beyond this daily routine of toil, confining his attention solely to the obtaining of money—hard earned dollars truly, in the strictest sense of the word.

Men and women must still toil with their hands, it is true, but it may be an intelligent labor, mitigated and facilitated by those appliances brought into regulation by the inventive mind, plainly indicating that this God-like power implanted in man is designed to preside over and direct his physical energies, and by so doing elevate agriculture and make farm life less laborious, while at the same time it is rendered more respected and attractive.

One very unpleasant feature of farming which is persistently followed by some is that of always being behind time. All the operations of the farm are carried on upon this principle. From January to December, it is the same without variation. The admonition to be "instant in season," is totally disregarded, if not forgotten, and one of entirely an opposite character substituted instead. This is entirely wrong. To be successful a farmer must be up in the morning, his work should be planned before hand and performed at the right time, as this often makes one-half difference in the results. And not only should the different kinds of farm work be done in season, but the labor of the day should always be brought to an early close. There can be no reasonable excuse for continuing this until into the night. Nothing will tend more perhaps to discourage farmers' sons, to say

nothing of "hired help," and bring the occupation into disrepute than this practice. Then we say, to assist in making farm life pleasant, let everything be done in season and in order.

If this rule is followed, a spare day may now and then be afforded for rest or recreation. From sun down until dark may be delightfully enjoyed in reading, social converse, walks about the farm, or among the neighbors, and a contentment and independence realized which would be gladly possessed by many others of a different calling or position in life.

It is quite time also that the prejudices existing against book farming, as it is termed by some, should be done away with. There is no reason why the education of farmers should not bear some relation to their occupation, as well as that of other callings and professions. The tendency of the age is in this direction, and is a good omen of future success. Those farmers already established in life cannot of course expect to avail themselves of these privileges, to the same extent with those younger in years, yet if so minded they can improve their opportunity to such advantage as to greatly benefit themselves. A very successful farmer of New York State was left an orphan at an early age, attended school only twenty-six weeks, yet such was his desire for knowledge, and his ambition to obtain it, that he overcame all difficulties, and to-day occupies a most prominent position as an agricultural writer and lecturer. He has made a practice, we understand, of taking up one study a year and mastering it in that time, and by this method has obtained a large mass of information upon different subjects.

The numerous periodicals and books upon agricultural science and practice furnish an almost unlimited fund, from which the farmer can draw at pleasure, and in this way in-

form himself upon any point connected with his occupation, and those so doing will be found more enlightened, less prejudiced against what are termed innovations upon old-time practices, enthusiastic in their calling and generally successful.

As results of this order of things we expect to see labor-saving implements and machines used wherever practicable; the strength of the horse and ox substituted for human muscle, while the farmer, with mind well stored with sound and practicable knowledge, presides over and directs the various operations of the farm, at the same time preparing the way for further and still greater progress and improvement. The farm with its fertile fields, its fruitful orchards, its well-bred and well-kept flocks and herds, will speak of thrift and prosperity. The buildings adapted to the purposes of the farm will tell the same story, while the house with its pleasant surroundings and appointments will be indeed a cheerful happy home.

Education will go hand in hand with agriculture; science will lend its aid to assist him in his onward career; books will be his companions, especially those relating to his occupation; social relations will be cultivated, thus fulfilling more perfectly the law of love which should be that of our lives. Possessed of these qualities and characteristics of mind, with congenial taste and disposition, we can see no reason why farm life should not be rendered pleasant and profitable, as well as what God designed it should be, the purest and noblest employment of man.

Mr. Jameson, of Irasburgh, made a few observations upon the subject of Mr. Towle's paper, in which he remarked that our Vermont people do not stand up for their State as the western people do. Yet they should, for they have abundant

reason for doing so, and a fair statement of the comparative advantages of different sections, with the evidence, might do much to stay the tide of emigration. Young people love to be in the best place, and while capitalists at the West advertise so largely, and hold out so many inducements, who will stand up for Vermont? He thought many of the representations of the West founded not altogether in the truth.

Prof. Collier said that not only is there a pleasure and satisfaction in beautifying farm life, but there is actual pecuniary profit in doing those things suggested by Mr. Towle for the embellishment of the farm. To adorn the homestead is to add to its desirability and increase its selling price. It also gratifies our sense of beauty. It pays to make our homes pleasant. We are placed upon earth for something else than to pay for our farms. Farmers in Vermont, as elsewhere, are short sighted as to this matter. They will pay a high price for improved stock, and neglect their houses, while the latter will pay as well as the former. It pays to do all these things, and do them well. At all our fairs beauty takes the palm, and why should it not at home. I have noted that the awards at fairs depend very much upon the taste displayed in preparing the articles for exhibition, and those are apt to be most tasteful in this, as well as in preparing farm products for market, who have trained themselves to habits of order and neatness about the home.

Mr. Slade. I am not a farmer, wish I was. What makes the desolation of our State in young men, is unattractive homes and too large farms. Addison county could have had a much larger population if her farms had not been over one hundred acres. The bareness of home life, about so many of our farms, is the cause of so much of the dissatisfaction among the young people that leads them to

leave their homes for the cities or the West. How much better for our State if our young people could have been induced to stay here. If a different policy could have been pursued, a member of Congress would not have been lost to Vermont.

Mr. Loyal Wright, of Middlebury, thought it was time to hear from the farmers on this subject. The whole matter lies in their hands, and their morning star will rise whenever they them elves choose to have it. The skinning process has been carried on upon farms from the beginning; our grandfathers took off the hair, our fathers the hide, and we are left to pick the bones. We have got to take a new course. There is a general running down, especially at the back part of our farms. We have been planting our beans wrong side up. As the Governor says, the boys go, and the girls follow. We must take hold of good culture, learn to be thorough, set about restoring our land, quit stripping it; plant trees, especially fruit trees, and invest our profits in improving the land instead of investing it elsewhere. We are apt to make a small part too good, and neglect too much the major and outlying part. It had been a question with him some years since, whether he should put his money in the bank, or back into the farm. He was thankful he had pursued the latter course, and the result was his son would stay at home; he could not be driven West.

Dr. Hoskins, editor of *Vermont Farmer*, of Newport, had no doubt large farms might be more profitable than small ones, if capital and corresponding ability were employed in their management, but he thought it wrong to increase their acreage, instead of expending their surplus funds in making the present area as productive as possible. On his way here he had been shown a farm of eight hun-

dred acres, that gave evidence, even while covered with snow, of not being as well cultivated as it should be. It would be better to sell one-half and put the capital into the remainder.

Prof. Collier remarked upon Mr. Wright's statement that we have the skeleton left; that the farmers, in many cases had not only skinned and picked the bones of their farms, but were actually selling the bones.

Prof. Seely, of Middlebury College, thought the paper of Mr. Towle more important than one how to raise good crops. If our farms were made more beautiful, more of our sons and daughters would turn to them. The times for relaxation and thought should be observed, as recommended in the paper. His recollection of farm life in his youth was principally that of feeling tired, tired, tired, when night came. Farm life has been made too hard, it needs something to lighten it and make it enjoyable, as it should and might be. He had been a farmer, and hoped to be again, but not in the old way.

Col. E. S. Stowell, of Cornwall, spoke of the value of the Board to the agricultural community; he said the farmers generally did not yet know what it was, or what it is doing for them. It is doing its work admirably. The knowledge it is communicating will reach the masses, and the State will be immensely benefited by the labors of this Board. Good things move slowly, but there is no cause for discouragement, even though the attendance was not large at first. He also endorsed the idea of Farmers' Clubs most warmly, and urged the immediate establishment of one or more in this vicinity.

Gov. Slade expressed the hope that the farmers would send in petitions to the legislature for a liberal appropria-

tion to secure the best men to read papers at the Board meetings, and to pay for them.

Hon. Henry Lane spoke strongly in favor of the establishment of Farmers' Clubs in every town.

Prof. Collier made some remarks to a similar effect, stating that in one neighborhood, so slight was the intercourse among the farmers that three of them had put up expensive barns, and neither of them had seen the barns of the others. That might do in New Zealand, but it should never be the case in Vermont. He did not believe farmers could ever be induced to use their power, when united, to oppress others.

Gov. Slade moved a vote of thanks to the Board, and those who had presented papers before the meeting, which was passed. The Governor observed in moving this vote that he never was so much interested and instructed at any previous meeting he had ever attended. Farmers should turn out better; they need just the knowledge they get here. He spoke also of the importance of supporting a State agricultural paper, and said, although he was not a farmer, he had himself subscribed, and hoped every one present would do so,

# VERMONT AS A HOME.

**A PAPER READ BEFORE THE STATE BOARD OF AGRICULTURE, AT ITS RECENT MEETING IN ST. JOHNSBURY.**

**BY Z. E. JAMESON.**

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The love of home is an affection that should exist in the minds of the majority of the citizens in every prosperous country. It aids in bearing with patience the disagreeable circumstances that will cross the lives of all. It tends to contentment and happiness. It is the battle cry of nations, and inspires the soldier to deeds of valor and daring. It exists in the minds of children; a glorious halo seems to rest around the memory of the old hearthstone, brothers, sisters, and especially parents; the fields, flocks, herds, fowls, as well as our favorite play grounds, all rise up in fond recollections. We sympathize with a true love of home, even by those who have left homes of want and oppression.

A recent writer, speaking of his journey through Ireland, where he saw miles and miles of stunted herbage and beds of peat, a robust but ragged peasantry, miserable hovels, &c., says:—"So overwhelmingly are the Irish in love with their country, that I fancy in their secret hearts they believe it had an immortal history before the external and rather superfluous entity known as the earth was created." They

never tire of speaking its praises. It is so with many foreigners. But I fear in Vermont but a small portion have a sincere respect and affection for the place of their nativity, regarding it so lightly that, as the spaniel shakes from him the superfluous water and hies away after a cooling bath in some other brook, so the Vermonter with the same carefulness skakes himself free from home, relatives, and all early associations, and seeks new scenes. Old parents are in loneliness, wearing life away. Children early throw off restraint, and the man who so easily divorces himself from other ties, does not always hesitate to sever the marriage relation. The item is afloat that "three hundred divorces were given in Vermont last year," and at the West who can number them? It is a by-word and a reproach.

We infer that the love of home is not deep-seated in Vermont, because her rural towns are losing in population. One writer puts the loss at 30,000 from the agricultural districts. Referring to Windham county, he says: "In every direction we find the relics of an ancient household, a few decaying timbers, an old cellar, and the crumbling chimney." An old school teacher says that when a young man he taught a school of seventy scholars in one district on this hill. In this district there is now no school, no scholars, and only two houses inhabited. In another district adjoining, in which there is not a single house standing, he taught a school of sixty scholars.

Thirteen towns in Caledonia county have lost in the last decade an average of over one hundred each; the town of Waterford two hundred and ninety-four, and Danville three hundred and twenty-seven. If I may judge these towns by Irasburgh, that lost only forty-six, I should believe that in many instances the deserted farms had been joined to others, so that what was once several homesteads is now one large

farm. It is an easy matter to count a dozen homesteads thus given up in almost any of our towns, and as many of these are well situated, with fertile soil, we infer that the love of home was not a prominent virtue in those who left them.

Now what do we know? We know there are many people in the State that do not make necessary improvements and repairs, because they are intending to sell the first chance they get, and therefore are afraid it won't pay. We know there are others who are making improvements and repairs on purpose to sell, and believe it will pay. We know there is a large class that believe if they were out West they would be much better off, and no matter how low Vermont is rated by returned travelers, they will not resent any insult heaped upon the State or its people.

It is but a minority to whom can be applied the glowing words spoken by Gov. Andrew, of the people of Massachusetts: "Looking forward to the long ages of the future, building always in their own minds for countless generations yet to come, they have endured and are still willing cheerfully and hopefully to endure much wrong, and more misconception, because they trust in the blood inherited from heroic ancestors, in the principles of constitutional liberty, in the theory of democratic institutions, in the honest purposes of intelligent masses of the people everywhere, in the capacity of truth and right ultimately to reach and control the minds of men, in an undying affection for their whole country, its memories, traditions and hopes, and above all, in the good providences of God."

If the merits, the history, the present and future of Vermont, are not enough to inspire the same feelings in our citizens, it would seem to be the plain duty of this Board to go forth as spies to find another favored section where all can

go and love their homes, take pride and invest their capital in them. No country can stand the continuous drain of both young men and capital, that has been going on in Vermont the past years. There has doubtless been over $150,000 carried West from my own native town within fifteen years. Who can estimate the amount carried from the whole State? Who can value the educated minds, the productive power and enterprise, that are lost by the removal of our young men? Mountains covered with timber, full of iron, copper, marble and slate, water power to turn machinery, fertile meadows and hillsides that should yield abundantly of all vegetable growth that sustains life, all is of little value without men to move these treasures and utilize these forces.

Some speak with contempt of the increase of population at Rutland, Burlington, and St. Albans, saying it is of an illitorate and transient character, and therefore of little value to the State. But not so, for at the head of these enterprises are men of intelligence, who by their planning and direction cause a thousand arms and hands to do their bidding, thus making them like their own hands increased a thousand fold in power. An ignorant, unskilled workman wandering loose in society may be a source of weakness, but when his whole strength is engaged by the ablest talent in the country, his productive power is of more value probably than the self-directed efforts of an ordinary man.

A writer from Illinois estimates the value of Chinamen to the State at $2,000 each, the moment they are landed in their midst. The conclusions are that every home broken up in Vermont and transferred to the West is a loss to us of all the money carried away, and certainly $2,000 for each individual. Notwithstanding our regrets for the depopulation of the State, it is very right and proper for it to continue if there is no merit in our soil, climate or surround

ings. If straight, practical farming, that basis of true prosperity, *cannot be made profitable*, it is useless to try and stop the outgoing tide of emigration. We should rather hasten the departure of all that are able to go.

There is a deal of sense in the words of an early English writer: "Those things should be called goods that are beneficial to the master. Neither can those lands be called goods which by a man's unskillful management put him to more expense than he receives profit by them. Nor may those lands be called goods which do not bring a good farmer such a profit as may give him a good living." This is the true test of merit. The English tenant farmer knows nothing and cares nothing for rise in lands, beautiful locations and showy improvements made with a design to sell. He studies soils, manures, crops, and pays his rents with the price of produce, and gains wealth by farming. With this view of the case how does Vermont compare with other sections? By referring to the reports of the Agricultural Department at Washington, I find that in 1867, only two States in the Union raised more wheat per acre, and only one State raised more corn per acre. In 1868, no State raised as much wheat per acre, and only one State more corn. In 1869, two States gave a heavier yield per acre, and four States more corn per acre. In 1870, Vermont is ahead of all the States on corn, and there are eight States where the price of corn was less than fifty cents per bushel. In four States the yield of wheat is more, while eight States yield less than ten bushels per acre.

I am aware that in other States more acres are cultivated on each farm than is the practice in Vermont. But the figures brought to your attention show the fertility of our soil, and capabilities of our climate. Consider also that the ordinary hay crop is worth as much per acre here as the

corn crop at the West, and in the hay crop is where our acres tell. In Iowa, 32 bushels of corn per acre at 34 cents, is $10.83 per acre; a ton of hay in Vermont more than equals it in value.

But let us drop details, and admit that the farmer in Iowa can plow his farm of, say, 100 acres, and raise 3,200 bushels of corn that would bring him 34 cents per bushel. To balance this, the Vermont farmer on 100 cleared acres can keep fifteen cows that will yield as much profit; for his butter averages higher per pound than the Iowan's corn per bushel.

A farm at the West devoted to raising grain for market does not improve in value. There are usually very poor accommodations for storing crops. The grain is sold, and nothing remains behind, with no other source of income. But upon a Vermont dairy farm run to its full capacity, there are many other items of income such as calves, pigs, pork, poultry, sugar from the woodland, and then the large quantities of manure cause abundant crops from which a surplus is often spared. I have the statistics of over 700 farms in Orleans County where all items of produce are given by the farmer himself, but it is useless for me to give you the items of his income, for I doubt not every farmer among this audience knows of many instances where men have bought farms on credit, and from the produce have paid debts, supported families, built good buildings, filled their houses with comforts, educated their children, and improved their farm and stock. If this is so, as I know it is, then we can say farming, plain, simple, practical, legitimate farming, pays in Vermont. Yes, pays, notwithstanding the constant draining away of strength and capital to the West. If Vermont was constantly receiving a tide of young, healthy emigrants, with thousands of dollars to in-

vest in our various industries, I doubt not our prosperity would excite the wonder and admiration of other States and nations.

Let us now consider one of the principal causes of the popularity of the West. 1st. The rise of real estate. It is said that a man with a few thousands of dollars can go out there and buy land and not lift his finger to work, yet will increase in wealth faster than he can in Vermont with all his industry. This seems to overthrow the doctrine before quoted, "Nor may those lands be called goods which do not bring a good farmer such profit as may give him a good living," as these lands give no profit, yet the man grows rich.

A former resident of Orleans county came from Illinois last year. He went there with one thousand dollars fifteen years ago. He recently buried his wife, (an event that frequently happens to our western emigrants,) sold out, and was worth $10,000. He says, "I did not make it by raising corn at eight cents a bushel, as I have sold it at that price, and burned it for fuel all winter. I made my money by rise of land, and shall now go West and invest it again." This rise in real estate depends upon the direction new comers take. There are settlements in Wisconsin that at this time are disconsolate because they are in debt. Their crops were partly destroyed by storms, and at the low price hardly paid for the necessary help to harvest them. Money commands a high rate of interest, and no one comes to pay them double the price they paid, and they look with the greatest interest and anxiety to see if Congress and eastern capitalists will build a railroad to bring men and women to their relief.

We freely admit that land does rise in value at the West. Its first cost is nothing. A homestead for $15.00! But how

is it in Vermont? At one time I set myself to compiling an array of statistics to show that the good farms that pay debts and support families do at the same time rise in value. But I found the proof so plenty that it seems useless to make a statement. On every road, in every town, there are cases in point. A friend from Craftsbury writes me that farms have advanced in ten years, on an ayerarge, 30 per cent. and in some cases much more, where no permanent improvements had been made except in fencing. He gives the following from many instances of farms sold:

One in 1854, for $1100; in 1857, $1600; in 1867, $2500. Keeps six cows and team.

One in 1854, $1600; in 1863, $2500; in 1866, $3000. Keeps twelve to fourteen cows and team.

One in 1854, $1400; in 1860, $1800; worth 1870, $3500.

In Irasburgh one farm of 220 acres cost in 1858, $6000. In 1868, 170 acres were added at a cost of $2500, making a total cost of $8500. It is now worth, $16,000.

Another farmer paid in 1850, for 220 acres, $3500. It was worth in 1870, $12,000.

A farm of 60 acres in 20 years has advanced from $500 to $3000.

But why should I enumerate instances? Wherever a man farms to make himself a desirable and profitable home, his land rises. Where men avoid making necessary repairs, because they intend to sell soon, their farms do not rise rapidly.

By the reports gathered by the Agricultural Department in 1867, lands had then advanced from five to thirty per cent. all through New England since 1860. They did not bound upward as the price of gold rapidly advanced, neither did land recede to its former price as gold approached par

value. In most cases the rise must be attributed to the improvements upon the land, the improvements in prices of produce and improvements in methods of cultivation, so that larger incomes are received from the lands and they therefore become desirable. We have reason to believe that if the capital gained in Vermont can be in a good degree kept here, our prosperity is but begun. The hundred years of labor and sacrifice incident to the early settlement of a country should not eclipse in glory the one hundred years succeeding, that may be likened to those years of strength and vigor of youth passing to manhood.

But such results will not be realized if all our thoughts and care are chiefly to build up the West. Railroad men invest their fortunes in its new lines, farmers send their sons with all their strength and talent, and all the money they can raise, and their fathers move into our villages and tell other young men of the prosperity of their sons, and while the money is freely spent at the West for churches, schools, ware-houses, the fathers at home, (blessed be the memory of their industry and frugality,) have passed their days of production and live to save and spend grudgingly, and seldom favor improvements of public buildings, sidewalks, roads and schools. Then our institutions of learning, literary and scientific, seem to feel that it is not for Vermont that they labor, as this leading idea in the report of the Trustees of the Vermont Agricultural College for 1869, shows; "There are indications that there will be an increasing demand for instruction in these courses. The vast expansion of the American railroad system, and the rapid development of the *western* mines, call for a large number of thoroughly trained men in civil and mining engineering." If Vermont was crowded and hundreds of

hands hanging in idleness, it surely would be more justifiable to so educate the young that they might go abroad.

Of the social, educational, and religious privileges of Vermont, I cannot boast. Many neighborhoods are so bare of young people, that stillness and dullness and almost a mouldiness rests upon the community. Churches are without pastors, and pastors are without proper and adequate support. Common schools are small, and academies, with their apparatus, and museums, and libraries, fall into dilapidation.

For myself, I was born upon a farm that my father had tilled for nearly fifty years. Within twenty rods of my birthplace my own home stands, where by farming I intend to share the fortunes of Vermont farmers, believing that the beautiful valley of Black river, containing thousands of acres of land (of which my farm is a part,) free from stone, rich in the elements of plant food, is as favorable for the home of a prosperous and contented people as any section of this wide country.

Following the reading of this paper considerable discussion sprang up, and various opinions as to the best way to prevent the depletion of the State by emigration were expressed.

J. P. Foster, of Barnet, expressed his views, to the effect that farm life was not sufficiently embellished by attention to those points that make it agreeable to the young. He had begun life himself at the bottom of the ladder, being a penniless orphan, bound out by the town at an early age, and had raised a large family, educated them, losing some by death after long and expensive sickness, but he had accumulated a competence by farming, and had done it without subjecting himself or them to that killing toil that so many farmers in-

flict not only upon themselves but upon their families. His children did not leave him. They were contented to stay at home. One of his boys had emigrated West, but returned after six months experience, perfectly satisfied with Vermont. He taught his boys farming in all its branches, devoting a part of the time to fruit-growing and gardening, with success that was not confined to the pecuniary results, but gave that comfort and satisfaction which makes the homestead truly a *home*. He had left his boys to-day to see to the sugar orchard while he attended this meeting, while farmers who had driven their sons away by hardship were now dependent upon Canadian and other help that could not be trusted. He was an uneducated man himself, but he believed in education, and thought our country schools should teach botany and other branches connected with rural pursuits, and calculated to raise them above drudgery. He looked forward to a more intelligent, better educated community of farmers, and thought that in the future brains must co-operate with hands to make farming pay.

Mr. E. L. Hovey, of St. Johnsbury, said that as a young man he thought he could give good reason why our young men went West. It was not because they did not love old Vermont. When this country was new young men came in, took up land and made homes for themselves. But now, when a young man wanted to buy land he found he had competitors in the wealthy farmers around him, who were on the alert to buy up all the small farms, such as a young man could buy and handle with small means. It was impossible for a young man to buy a large and expensive farm, without capital to run it, and ever pay for it. It could not be done.

Another trouble was that Vermont farmers will generally hire an Irishman or a Canadian for twenty dollars a month,

rather than pay their own sons twenty-one dollars. That being the case, the boys went West, where they could get both work and land. Make it for the interest of the young men to stay here, instead of crowding them, and they will stay. They love their old homes, or will if you will let them do so.

T. H. Hoskins, of Newport, expressed the opinion that there were already farmers enough in most parts of Vermont. The tendency toward the growth of farms by adding one to another, as spoken of by Mr Jameson and Mr. Hovey, was the natural and inevitable result of the increase of capital in the hands of the farming class. Large farms with sufficient capital can be run to better advantage than small ones. What we want in Vermont to retain our population is the development of our manufacturing and mining interests, not only to afford markets and build up cities, but to give an outlet to the various abilities of our citizens. He was himself a farmer by natural inclination; he loved the very smell of the soil, and could derive a pleasure from watching the growth of crops and animals that he could get from no other occupation. But he recognized the varieties of talent in mankind, and he was well aware that we were not all born to be farmers. For men with no "call" to agriculture there is very little to do in Vermont. Let the State and the people encourage the development of our mineral resources and our manufacturing opportunities. 'If a farmer has a boy who does not take to farming, give him a good general education, (which is the basis of all special training if you want it to be effective,) then put him where he can learn the business he likes. When he is trained to that, don't be afraid to entrust him with capital if you have it, to establish himself here at home.

He did not believe that Vermonters do not love home. But they have got a living to get, and however sadly and re-

luctantly, they must turn their backs on the green hills if they offer them nothing to do. It is not to the West alone, but to the busy villages of Massachusetts and the work shops of the cities, that our population is drained away. It is contrary to nature for the natives of a mountainous country to be indifferent to its charms. Fill our valleys with the industries they await, and our young men and women will stay with us. They will find work to do of every sort to suit their tastes, and in doing that will furnish quick and abundant markets for the products of the farm, the orchard and the garden.

It is not necessary for us to wait the advent of capital from the great cities. We have capital among us to begin the work, and once rightly begun it will carry itself along. He did not believe that great cotton and woolen mills were what we want. Let us take hold of our forests and our minerals. They furnish raw material in abundance. We now send to other States for most of the very things we could make at a profit. Farmers, you are the capitalists of Vermont, and if you will, you can give your sons and daughters employment and keep them at home. You furnish the capital that is carried West. Let that money be invested in industrial enterprises here, and instead of being a total loss it will bring a double profit,—a profit from its direct use, and another from the market it will make for the products of your land.

The emigration from Vermont was not peculiar, for it was even greater from Maine, and quite great from all the eastern States. Farming at the West is no more, if as profitable as here, and the comforts of life were much less there than here. The rise of property at the West was what made the difference, and not the profit of farming industry. He counted it a good sign that the interest in schools, and in ag-

riculture based upon knowledge, was increasing throughout Vermont. He hoped to see the farming interests organizing themselves, and felt certain that in such organization they might be as powerful for good, as are those banded associations of ignorant miners in Pennsylvania, at whose mercy are the manufacturing interests of the country, powerful for evil. Besides, too, in the co-operation of the intelligent farmers they would have the sympathy and help of all in their good cause, just as now the coal miners have the opposition and execrations of all. For himself he thought that the material advancement of Vermont was not "played out;" it was but just begun.

He referred to the beautiful village of St. Johnsbury, in which we are assembled, as a proof and example of what he was trying to impress upon his hearers. Here, from small beginnings, had grown up an industry that was blessing and fertilizing this whole region. The farmers felt its influence in all the ways he had alluded to, and in countless other ways. Here were the best schools, the best library, the finest examples of many fine and useful arts that Vermont could show, all sprung from the little blacksmith's shop, started with borrowed capital, that had grown to be the largest manufactory of its kind in America, if not in the world.

Maj. N. P. Bowman, of St. Johnsbury, did not believe that farming generally was profitable in Vermont. Those who selected the richer valley lands perhaps had made money, mostly by the advance caused by railroads and manufactures. The hill farmers were many of them in debt, and their condition was not improving. He was not a farmer and might not be correct in his views, but he had a strong conviction that he was.

Mr. J. P. Foster strongly controverted the remarks of the previous speaker. He was a farmer, and a hill farmer. He had worked under many disadvantages, but he had paid his way and accumulated a competency, and was not an exception in this respect. When he was a young man old Gov. Fairbanks had offered him work in the scale works, but he had chosen the farm. He was told that he acted unwisely, yet few mechanics had done as well as he had done. But he confessed the benefits that manufactories confer upon the farmer.

C. M. Stone, Esq., (editor of the St. Johnsbury *Caledonian*,) said that he felt that Dr. Hoskins had struck the key note of the future prosperity of Vermont, when he said that her great need was a diversified industry. He spoke of the introduction of manufacturing into the State, and its slow progress. The lack of transportation had been an obstacle to success in this branch of industry, but this was being overcome by the increase of railroads that, when finished, would give a choice of markets, and reduce the cost of freight which without competition was apt to be so high as to make manufacturing unprofitable.

# VERMONT AS AN AGRICULTURAL STATE.

A PAPER READ AT THE MEETING OF THE BOARD OF AGRICULTURE, &c., AT MIDDLEBURY, FEBRUARY 7, 1872,

BY DR. T. H. HOSKINS, EDITOR VERMONT FARMER.

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I cannot but feel a regret that the people of Vermont are, as a mass, so incredulous of the advantages their State has as a place of residence, as a future seat of extensive mechanical industry, and above all as a region favorable above most others for the successful prosecution of agriculture in its most profitable departments.

These advantages must be very imperfectly understood. Else why do we find so many of our farmers desirous of leaving their native State; not, as a rule, to engage in any other employment, but to continue the tillage of the soil in some other locality? It is natural, so long as we have little commerce, and comparatively few manufactures, that our surplus population—the young and those who have their fortunes to make—should go elsewhere for a better field. Doubtless there is a better field for such in the manufacturing and commercial towns of neighboring States, or on the cheap lands of the West.

But we all know that it is not by any means from that class alone that the emigration from Vermont is made up. Every year, hundreds of substantial farmers, men who own

good farms and are free from debt, sell out, pull up stakes, and away to Kansas, Iowa, Wisconsin, and Minnesota. Why do they do it? If I am right, it is done under a delusion—a double delusion, I might say—that magnifies the advantages of the West, and woefully underrates the advantages of Vermont for the prosecution of the arts of husbandry.

I know the West, and I do not say it is a bad country for the farmer; no doubt from its extent, and the general goodness of its soils, it is to be the seat of the greatest agricultural development of our time and country. But I do say, speaking not without reason, that for the kind of husbandry to which it is best adapted, our little Green Mountain State (as we call the 10,000 square miles that lie between Champlain and the Connecticut), has no superior—in sober truth it has few equals—between the Atlantic and the Pacific.

It is not so long as an old man's life-time since everything that is now said in favor of the very best regions of the West was said, and truly said, of Vermont. The natural strength of Vermont soils, especially for the permanent production of grasses, roots, and grains, is not surpassed anywhere. The present fertility of most of our land, it is true, is exceeded on new land of equal quality elsewhere; but by the same process, in less than the life-time of a generation, these new lands will be brought down, in a vast majority of cases, far below the point to which it is possible, even by the worst management, ever to bring the soils of Vermont. It is one of the greatest errors to regard the soils of the West as inexhaustible. In numerous cases, even the latest settled States, like Iowa and Minnesota, already refuse to yield profitable crops without manure; and in Illinois, (to say nothing of older States like Ohio,) the condition

of things in this respect is very fast approaching, and even falling below, our own level. There has been much exaggeration in regard to the prairie soils. In natural strength, the strength that is left when the accumulated vegetable matter of the past has been extracted and carried away in ten or twenty grain crops, these soils are *poor*, compared with those of Vermont; and it will not be long, under the present system, before we shall hear of large areas in those States turned out as waste land, no longer profitable, either for tillage or for pasture. As a proof of what I say, it is only necessary to consult the columns of the Western agricultural papers. The "brag crops" of the West are *small*, even with manure applied liberally. A late number of the *Prairie Farmer* says:—"Mr. Henry Wood, of Sycamore, Ill., reports that he has husked this year, 500 bushels of ears of corn from four acres of land, and threshed twenty-five bushels of wheat to the acre. *His wheat land was heavily manured.* Mr. Jacob Siglin, *who also manured his wheat land*, raised 26 bushels to the acre."

Even in those rich, wooded States, like Missouri, most resembling Vermont in the character of the land, the absence of that very winter climate, against which so many object, and which so many urge as a reason for emigration from Vermont, is a great disadvantage. We do not reckon at its real value the coating of snow that lies every winter upon our fields and pastures; protecting the nutritious grasses, giving them that *peculiar* protection and support which bring them to the highest perfection as food for our domestic animals. There is much truth in the saying, that snow is the poor man's manure, and no stock-raising country that is without it can compete, in certain directions that are very profitable, with those that possess it.

I have no doubt that many of this audience will find it dif-

ficult, perhaps impossible, to accept my views of the value of Vermont as an agricultural State, and especially my anticipations in regard to her future prosperity. But what I have already said to you in regard to the positive and permanent value of Vermont soils is not a matter of question, it is a simple fact, and it is in vain that any dissatisfied farmer goes wandering over the country seeking for land that has more permanent value than ours. The chances are many to one that he will light upon land that—however it may seem to be more productive now—will in the end show itself incomparably inferior to that he left behind him.

It is true that bad husbandry has, all over the State, reduced the immediate productive value of even our best lands. But on this point I commend to your careful study and consideration the statements of America's best agricultural chemist, Prof. Johnson, in his recent address on the Exhaustion of Soils, before the Vermont Board of Agriculture. He there demonstrated that every soil has a natural strength that can never be exhausted, and if that natural strength is great, no matter how many generations may abuse it, the first generation that has it, and the knowledge, may easily, quickly and profitably restore to it the fullest productive power that it ever possessed, and by good husbandry may then continue it in that productive condition to the end of time.

Taking it then as a fact not to be successfully disputed, that Vermont had originally a first-class soil; accepting the statement of competent and thorough scientific men that a first-class soil cannot permanently be made anything less than a first-class soil, or even be reduced beyond easy recovery, the question becomes at once a practical one,—Why should the future of Vermont, as an agricultural state, be anything else than a brilliant one? Why should her

farmers, who own land and mean to continue farmers, ever leave her to seek other fields upon which to expend their skill and labor?

But *good soil* is not alone the single requisite for the best or greatest success in husbandry. Nearness to a good market is equally important to the farmer; and here it is easily shown that Vermont has an unrivalled position. Vermont is the nearest first-class farming land to the best markets for agricultural produce in America, the manufacturing districts of southern and southeastern New England. Her position as regards the market of that great hive of consumers clustered about the mouth of the Hudson river is not inferior to that of any rival. But better than all, in the near future there is, I firmly believe, to spring up a market right among us, similar to that with which the farmers in the vicinity of St. Johnsbury are favored, dependent on the increase of manufacturing industry in our state. Such a market will yield us our best profits, because the cost of transportation will not have to be deducted from our returns.

I know that there is a feeling of incredulity in Vermont as to any great development of new resources, any new springs of wealth, in our midst. Indeed, I am astonished, when I talk with the people, to see how little faith they have in the future of our state. "Vermont will never be much more than she is," is a very common saying of Vermonters. But why are they so blind to the signs of the times?

Let us look around us a little. The United States, as a nation, is but at the outset of that career which is to make her within the next fifty years the greatest, the richest, the most powerful, the most enlightened country that has ever existed upon earth. Before this century expires, 100,000,-000 of people will be at work developing the resources

of North America. It is the greatest improvement that the world has ever seen. The industries that we now call great, in our commercial and manufacturing centers, will be dwarfed into insignificance compared with what the next thirty years will show us. In that time the present centers of industry existing within 250 miles of every part of Vermont will have expanded to more than thrice what they now are. Three or four millions of people will cluster in compact cities around the bay of New York; one or two millions around the peninsula of Boston; hundreds of towns and cities to the south and east of us will count their population by tens and hundreds of thousands. Can Vermont, standing almost in the very vortex of this whirl of busy life, stand still, and stagnate like a marsh? The very thought is impossible, when once we take in the future that is awaiting this great republic.

So far, Vermont has, comparatively speaking, lain a little to one side of the course of progress. But that great stream widens so fast that what was an eddy yesterday will be to-morrow in the full rush of the current. Already we can feel that current beginning to draw. The rapid development of our railroads is an indication of the set of the stream. The wave of commerce beats stronger and stronger upon our borders; its tide is wearing a way through our mountains at different points. And it is not alone the railroad that is showing this: some morning within a few years, we shall wake up and find Burlington, St. Albans, and the new city on Maquam Bay, seaports. Then, no longer an inland state, we shall see Vermont spring at once to a high position as a business community; her territory the highway of commerce by ship as well as by car. The ship canal from Lake Ontario to Lake Champlain is no local work; it is a necessity of the age, and is as sure

to come as the necessities of the great West for outlet to the sea are sure to continue and increase.

What follows from all this? Have you thought what must follow when Vermont has become from north to south a series of highways for the commerce of a continent? When the giant West, and the rich, commercial East make of Vermont one great high-road of traffic, what must of necessity be the result? Vermont at once becomes the very best locality for many kinds of manufacturing industry that there is on the continent of America. We have water-power for the machinery of a nation—the very best water-power because our rivers not only send an evener current, fed by their mountain springs, than those of other localities, not only make a greater fall within a shorter distance, but they are neither too small for profit, nor too large for control. I have the authority of skillful engineers for the statement that the force of our water-power can be put to use with less average expense in proportion to value than that of any other section of the country.

Everything will unite to invite capital into Vermont for manufacturing purposes, so soon as the great highways, now so near completion, begin to show their results in turning the tide of business across our State. In accessibility our mill-sites will be unrivalled; labor is abundant and will continue so, for not only will labor flow to us from abroad and from Canada, but, better than all, we shall keep our own sons and daughters at home, because we can give them paying work in abundance.

Then the productions of our land will have fair play, making food cheaper and better in our towns than in those which have to be mostly supplied from a distance. This is an important item in the cost of labor, and the consequent profit of manufactures.

Certainly every one who keeps himself informed in regard to what is going on in the world must observe how, starting from the older marts of business along the Atlantic, the circle of manufacturing energy has widened year by year. Take Boston, for instance, as one of those centers. Beginning on the milldam of the now extinct back bay; spreading to the mill-privileges of the Charles and Neponset rivers; reaching soon to the Merrimac at Lowell, Lawrence, Nashua and Manchester; meeting the smaller circles from Rhode Island at Taunton and Fall River; spreading into Maine, first at Saco, then at Lewiston and Augusta; pushing west in Massachusetts through Worcester and Fitchburg and many other towns, and meeting the upward tide from New York that has flowed up the valleys of Connecticut to Springfield, Holyoke, into the mountains at North Adams; already beginning in Vermont at Brattleboro, Bellows Falls, and other places; running north far up into New Hampshire—*it is already at our doors*, yet we do not see it, nor believe in it.

Assuming the truth of all this, (I am aware that some will not allow it,) it is not difficult to see that Vermont as an agricultural State has a bright future in store for her. All this business, when it comes, and it must come sooner or later, unless some paralyzing blight is to fall upon the energies of our country, will make a market for our farmers that cannot fail to make them thrive. But we ought, foreseeing the future, to be preparing to meet it, and to meet its demands upon us. The brightest minds, the strongest hearts among us *are*, to some extent, awakening to a sense of our position. To that fact I gratefully trace those signs of movement and activity that have given our State Agricultural Society the high position it occupies; has invigorated our County Societies; given birth to our Board of

Agriculture, our Dairymen's Association, the Vermont Horse Stock Company, the Champlain Horticultural Society.

There is no better work for the farmer, who feels in his heart the patriotic impulses that experience proves never to have been lacking in the hearts of Vermonters, than to give his energies to the promotion of every means of progress and improvement among us. What has already been done is well done, but it should only be a stimulus to us to go on. It is too late to say that agricultural science, as contained in books and developed in the oral teachings of men like Professor Johnson, or the Secretary of our Board of Agriculture, is unworthy the attention of practical men. The farming of all the foremost and most successful agricultural countries of Europe, is already placing itself upon that very science as the only sure foundation of success. Its value is so widely acknowledged, I say that it is too late to refuse to accept it as of practical value. It would be as sensible now to refuses to accept science applied to agriculture, as it would be still to re-echo the cries of those who once ridiculed the steamboat, the steamship, the railroad and the electric telegraph. The value of the one is as fully established as that of the others, and the farmer who refuses to listen to it is simply refusing gifts of inestimable value, gifts that, if he continues to neglect them, will pass into the hands of others, enabling them to outstrip him in every department of farm work, and to acquire wealth while he is struggling along to win a mere existence.

Farming is rapidly becoming a business requiring a better education, a wider range of study, than yet prevails among us. Many of its most important principles cannot be mastered without more and different mental training than is given in most of our schools. Most of the older men in the business must be expected to reject new ideas.

It is the younger generation who will receive the new gospel of the farm, and they will be glad to see their calling elevated to an equality with other occupations in giving scope to the highest mental faculties, and, by so much, separated from the drudgery of mere back-breaking manual labor.

It is plain that, before farming in Vermont can generally attain to so high a position, the schools of the State must be re-modelled, improved, and adapted to teaching the new lessons required by the new times. This, it seems to me, is the first work to be done in every neighborhood—the starting point of the new departure; and in no way can any man or woman, who desires to see a better husbandry, work more effectually to that end than in promoting those improvements in our school system for which our Board of Education is laboring. With the coming of that time when any large proportion of our farmers shall believe in and understand scientific farming, will come the time when the soils of Vermont, strong in natural fertility, will be restored to that high condition in which they were found by our pioneer ancestors, and kept there. Then, crops of fifty bushels of wheat to the acre will become common again; then the power of land to carry one head of horned stock to the acre, with a sheep or two thrown in, will be seen often enough to be believed in; then the possession of the best breeds will not be confined to half a dozen men in a county; then ten loads of manure will be made where one is made now, and every load will be worth double; then pilgrims, not few but many, will come from the South and the West to buy of us, not only improved Vermont horses and Vermont sheep, Vermont potatoes and Vermont beets, but Vermont improvements of every animal and every plant that lives and grows upon the farm. Then we may look even to have the young

men of other States who mean to be farmers coming to us and paying liberal fees for instruction in Vermont methods of breeding and tillage; coming to inspect Vermont farm buildings; to see in Vermont pastures Vermont cattle up to their knees in the best of Vermont grasses.

You may smile over my visions of the future, but I am not afraid to put them on record for comparison with the realities to come. At any rate, you will all admit that we need to make improvement—that we can make great improvement over things as they are; and when improvement once begins, who shall say where it will stop?

Nothing that I have figured before you is impossible, for there is not an item of it all that does not at this very moment exist as a reality in countries where, fifty years ago, farming was at a lower ebb than it is to-day with us—countries inferior, in many respects, to Vermont in adaptation to agriculture. And where is the Vermonter that will say he cannot do what any man has done, with no better opportunities than he to do it?

# THE TRUE POSITION OF THE AGRICULTURIST.

A PAPER READ AT THE NEWPORT MEETING OF THE STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING,

BY I. D. R. COLLINS, ESQ., OF CRAFTSBURY.

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In view of the interests which the Board of Agriculture was created to advance, I have thought that this topic might not be inappropriate to discuss at this meeting. In a paper restricted to the limits to which I must necessarily confine myself, of course but few points can be touched in discussing such a subject, and those few but briefly.

This paper, then, is intended only as a prelude to the discussion which may follow, and in which the topic may be more fully elaborated. In discussing this subject I have chosen to consider it in the form of a question, which I have attempted briefly to answer: What is the true position of the agriculturist?

First, negatively, it is not one of discontent with his business. By this I mean not that discontent with present circumstances which impels an individual to seek for advancement, improvement, a better state of things; for this kind of discontent,—if discontent we may call it,—is highly commendable in all, and even necessary to progress in any direction or to any degree. The lazy man is usually a con-

tented man, in that lazy sense of content which has for its motto, "All is well; let well enough alone." We would not have the farmer content in this sense, but that discontent which leads him to be forever bewailing his lot *as* a farmer, and forever wishing that Providence had directed *him* to some other occupation in life; that discontent which inclines him to believe that when the curse was pronounced —"In the sweat of thy face shalt thou eat bread, till thou return unto the ground,"—no other occupation in life was included, and that those engaged in the professions and other business pursuits of life are happily exempt from the stigma and consequences of the sentence then pronounced: this discontent leads only to a cringing servility towards all others, who are thus imagined to occupy a more noble and honorable position, and leads him to look with contempt upon himself and his occupation. This certainly cannot be the true position of the agriculturist. There is nothing either in the origin or nature of his employment that should lead him to look upon himself as in the least degree degraded in consequence of his connection therewith, but there *may* be that in his practice which *should* lead him to blush, not that he is a farmer, but that he is such a farmer as he is. The tint upon his cheek, painted there by the elements to which he is exposed, the calloused hand, made so by contact with the ax, the spade, the plow, are not emblems of degradation; and if they are so considered to-day anywhere, or by anybody, the agriculturists of this and past generations have themselves nursed the idea into life, and given it currency. It is this feeling, that the farmer occupies a low or degraded place in society, that leads so many to accept with such avidity and relish the fulsome adulations sometimes bestowed upon them in public addresses by politicians or others who have "an ax to grind," and seek to win favor from the

farmers by addressing them as "Noble tillers of the soil," &c., and if, perchance, the aforesaid politicians condescend to address them personally, and perhaps take them confidingly by the hand, patronizingly inquire their views or laud their avocation, (while they are really only seeking their votes,) it is the same feeling of inferiority and degradation that induces them to consider themselves honored by the association, and to accept such patronage with equanimity and complacency, and even with delight. I say, then, most emphatically, that such a view of agriculture as leads men to such conclusions is a wrong view, and induces its votaries to accept a wrong position.

Personifying agriculture, I would say, secondly: The true position is not that simply of wet nurse to the professions and all the other occupations of life. And yet how generally is this view entertained and this idea acted upon. Who is there among us, I will say even among those agriculturists who are the most advanced in knowledge, have the broadest and most just views in regard to the true relasion of things, and best love the avocation of a farmer,—who, if he is the happy father of an unusually bright and active boy, does not lay his plans, concentrate his efforts, and set his heart upon fitting that promising youth, the pride of his life, for a profession? And how often do we hear the observation, when a boy of this description is seen, "That boy ought not to be a farmer!" And all this in consequence of assuming a wrong position; reaching a wrong conclusion by reasoning from wrong premises. It is assumed, in the first place, that anybody knows enough to be a farmer, and that no preparation is needed, even for the most stupid, to "act well their part" in that avocation, while none but the bright and active can hope to "shine" in a profession, and they only after the most careful and thorough preparation.

The first part of the proposition is as false as the last is eminently true, and I here affirm that no occupation in life to which man has devoted his energies requires a more active mind, a more thorough training, or broader views than that of the farmer. There is hardly a science within the whole scope of human research, but has a bearing upon his business, and some of the most intricate of the natural sciences are those upon which, (unconsciously perhaps,) he builds all his successes, and scatters the wrecks of all his failures. The ranks of the professions and all other business pursuits, it is true, must be filled, partially at least, from the farm house, but out upon that idea which would make this the only aim of an ambitious youth, or more ambitious parents. 'Tis well, 'tis noble to fit a son properly to engage in the active duties of life, either in the professions or any of the numerous avocations to which his inclination or circumstances may direct him, but it is no less incumbent upon a parent to give him the benefit of a thorough education, should he choose the so-called "humble pursuit" of a farmer. Neither should the idea be allowed to gain possession of his mind that the only road to honor and distinction leads *away* from the farm. And yet how many farmers are daily, by their actions if not by words, instilling this very idea into the minds of their sons who are growing up around them.

But, thirdly: The true position of the agriculturist is not one of antagonism to those engaged in other pursuits. While he should not feel himself degraded in any sense by his occupation, neither should he feel that another is beneath him by reason of his employment, provided it be an *honest* business in which he is engaged. All labor is honorable, provided it is pursued for an honest end, and conducted in an honest manner. It is not the calling that honors the man —it is the man that honors the calling. It is as honorable

to be a day laborer upon the farm as to be the proprietor of the broad acres he helps to cultivate, provided the service rendered is done in an honest and conscientious manner. I do not claim that natural or acquired abilities or moral character should not have an influence upon the social position of an individual; on the contrary, *these* and *these alone*, should determine that position, and not his avocation or his wealth. "Worth makes the man, the want of it the fellow." Neither is the true position of the agriculturist one of antagonism to others pecuniarily considered. While all other classes in the community are primarily dependent upon him for food and raiment, he is also dependent upon them for the comforts of civilized life by which he is surrounded, and as other branches suffer when from any cause his is paralyzed, so also he must suffer pecuniary loss when they are prostrated. It is not for his interest to compel the merchant of whom he buys his goods, or the dealer to whom he sells his produce, to carry on business at a loss. Neither is it for his interest that the clergyman should be compelled to abandon his field of labor for want of adequate support, or the physician to emigrate for want of his fee. The mechanic is a necessity to him, and the manufacturer who runs his mills in his vicinity helps him on to prosperity. All are essential to his welfare. It is for his interest that all should prosper, and his true position is not one of antagonism to them.

Having thus answered the question negatively, in a few particulars, I will now attempt briefly to answer it positively. In the first place, a positive answer to the question will involve the opposites of the negative positions already taken, if I am correct in those positions; or, to recapitulate, the true position of the agriculturist is, first, one of satisfaction and content with his business; satisfaction to such a degree as

shall lead him to be a true lover of agriculture, and to entertain a sincere desire for its advancement and the elevation of all engaged therein. This feeling will impel him to engage with enthusiasm and enjoyment in the various details of his avocation, and to labor earnestly for the support of all those institutions which have for their object the advancement of agricultural interests and the spread of agricultural knowledge. He will feel no sense of degradation because he is a *farmer*, but on the contrary will feel that he occupies a position of true nobility, and that he is not simply by reason of his occupation rendered the inferior of the best and highest in the land.

Secondly, while he may feel it a duty which he owes to some of his children, whose natural faculties and taste incline them to the choice of a professional career, to fit them properly for such a position, and to give them up from the walks of agriculture with cheerfulness, he will feel that he owes no less to those who remain on the farm. He will feel that they have claims equally strong, and necessities equally urgent, to properly prepare them for their duties and the successful prosecution of their business; nor will seeming lack of mental activity induce him to withhold such opportunities as he may be able to afford for a broad and deep culture, preparatory to entering upon the active affairs of life. Who can measure the capabilities, or rather I will say the possibilities, wrapped up in even a sluggish human intellect? The dullest boy may make the sharpest man. And, thirdly, he will give his hearty support and co-operation to those engaged in all other branches of legitimate business. Enough has been already said upon this point to indicate, at least, that his interests are so intertwined with those of all others that no antagonism should exist, and if he suffers himself to assume such a position, and this in any degree

hinders the successful prosecution of such business, he will remotely, if not directly, bring injury upon himself and his own particular interests.

I have already indicated that the true position of the agriculturist is not opposition to knowledge, but I wish to make this idea more prominent. Many have scoffed at "book farming," "agricultural literature," &c., but I am happy to believe that there is a gradual advancement in the agricultural world towards a more just and true conception of the needs of agriculture, and a more correct position upon this subject. Says a modern writer, "What literature has done for theology, for astronomy, for all the sciences that elevate and adorn humanity, she is ready to do for agriculture, the art of arts, to which we owe all the comforts of civilized life." Perhaps this is too strong. Agricultural science, or rather science as applied to agriculture, perhaps has not yet reached that degree of perfection to which it has attained in some other directions, and consequently our agricultural literature may not be as accurate, but this is no reason why we should discard it entirely. But I quote again, this time from the editor of the *Rural World*, who says: "Book farming,—what is it? It is simply the best farming put in books—yours, reader, if it is the best: A fool can not write a book; an able man must do it –not a man of mere accomplishments or learning, but one versed in the business he writes upon. It is thus that we have books in the various departments, by the men best fitted, by their attainments to knowledge, to write them." These make our literature, and to be opposed to them is to be arrayed against knowledge, against schools and newspapers. What is thought of the man who is opposed to education in its more general sense? And what is education but learning to know a

thing? If he who is prejudiced against book farming knows how to raise a particular crop, or carry on any particular branch of farming, more successfully than others engaged in the same business, he is the man, if he has words for it, to write a book telling how he does it. And yet this would be called "book farming." This feeling of opposition to anything and everything that is published upon the subject of agriculture is mere prejudice, and I am thankful that it is rapidly passing away. No one who has carefully watched the advancement in agriculture, for the last few years, can have failed to observe that it is growing more scientific, though not, perhaps, less practical. It is now the aim of all intelligent farmers to unite science and practical skill. These two powers are not antagonistic, but each will aid the other, and by their help we may make ourselves familiar with the mysteries of nature, and remove the worst difficulties that have beset the farmer in his work. The thinker in his study, the chemist over his crucibles, and the earnest experimenter in the field, are laboring together for the discovery of truth, and it is only by their united efforts that the highest agricultural truths can be obtained. I repeat, then, what I have before affirmed, that the true position of the farmer is a hearty co-operation with everything that has for its object the diffusion of practical, theoretical, or scientific knowledge. It has been well said that knowledge is power; and in no occupation is this truth better illustrated than in agriculture. Allow me to point out the kind of education that seems to me best adapted to fit us for this position. Education produces an early and deep conviction that man was made for action; that he is placed among forces which he must direct, or to which he must accommodate his conduct; that all objects that exist, animate and inanimate, have received definite qualities, and that good arises from a proper,

and evil from an improper use of them. An education which makes known what these qualities are, the laws that govern them, and their bearing upon and relation to each other, invigorates the understanding, gives boldness and independence to thought, and gives a proper direction to effort.

It appears to me that the power of observation, on the strength and acuteness of which the talent for practical business so greatly depends, will be better disciplined and developed by studying the forms, colors, magnitude and arrangement of the different parts of minerals, earths, plants and animals,—in short, by studying, both theoretically and practically, the natural sciences, than by learning merely the distinctions in modes, tenses, genders and cases in two or three obsolete languages; and that the reflecting faculties will be better trained to vigor by investigating the natural and active phenomena presented in those sciences, than by contending with the subtleties of Greek and Roman authors. In the one case the faculties are employed directly upon the objects around him and with which he must continually come in contact; in the other they are occupied with artificial inventions in one department alone. In the one case every item of knowledge gained possesses an intrinsic value; in the other the ideas acquired are of slender utility beyond the discipline of the mind which the study of them affords. The attainment of proficiency in knowledge in this direction is now made accessible to our youth through the establishment of our agricultural colleges, and scientific courses, and though many of us who have passed that period of life especially devoted to study, and have been for years engaged in the active business of mature manhood, may regret the lack of opportunities which we had not, we should be thankful that such opportunities are

afforded for our children, and give those institutions our hearty support.

And allow me here to pause for a moment to pay a tribute to one who, though raised by the suffrages of his fellow citizens to the highest representative position in our country, is not ashamed to attach to his name in the United States Senate Directory, as descriptive of his occupation, the word "Farmer." All honor to Justin S. Morrill, the father of our agricultural colleges, the wise and dignified senator, the noble, intelligent, representative Vermont farmer!

But to return. There are other sources, however, from which we may gain information, and which are open to all, —to us in the manhood of our lives, as well as to the youth. One of these means is found in the farmers' club. We may gain much knowledge by communicating with each other, by an interchange of ideas and experiences, and I am happy to see this efficient means of diffusing knowledge springing up in so many towns in our State. This too should receive the cordial and hearty support of all our farmers. So, too, of the labors of this honorable Board with which we are met to-day. This is but another farmers' club, upon a broader scale, perhaps, and treating in a more scientific manner the various branches of our business, and consequently even more entitled to our co-operation than the rural farmers' club. There is also our agricultural literature, both in the form of books and periodicals. These we must not neglect. Most of them are written by practical and scientific men. We must read discriminatingly, to be sure, remembering that agricultural literature is yet in its infancy, and that many things will be written which will not bear the test of wide and general practical experience. Still we shall find much of truth which we cannot afford to do without.

A few words in practical application of the subject. Brother farmers, fellow tillers of the soil: are we occupying our true position? Are we fully sensible of the true dignity of our calling? Are we manfully striving to discharge all the duties and responsibilities devolving upon us? Are we making use of all the means within our reach to fit ourselves for the position which is ours by right? If not, let us be up and doing. We should be intelligently sensible of the dignity and importance of our calling, of its high character and indispensible necessity; we must be awake to a *manly* feeling, founded on the proud conviction that, instead of its present humble position of subjection to all other interests, agriculture deserves to sit on the highest seat, as the art of arts, adorned by science, caressed by power, and honored by the great and good.

Our statute books teem with provisions for the peculiar interests of other classes, securing exclusive privileges, often at our expense. Let us no longer stand as idle and uninterested spectators, but let us stand up for our rights, as freemen of this great republic, more than half of whose citizens are tillers of the soil. Let us manfully sustain the high character and dignity of our position in society, which *ought* to receive as much strength from our intelligence as from our wealth and numbers. Let us be no longer blind to our own interests, nor inactive in their defense. Let us assume and maintain our *true* position in society, in politics, and in the world.

Considerable desultory discussion upon the topic of Mr. Collins' paper here followed, which we will not undertake to report.

Prof. Collier spoke briefly upon Farmers' Clubs, their importance, and the desirability of their establishment in every

town in the State. He considered that they were most efficient aids to the work of the Board of Agriculture, whose meetings could be regarded but as a Farmers' Club in a larger form.

Capt. E. L. Hovey, of St. Johnbury, and Jonathan Lawrence, Esq., of Passumpsic, followed with some remarks favorable to the patrons of husbandry.

Mr Lawrence gave a very interesting account of the origin and progress of the order in Vermont. The first grange was instituted in July, 1871, and in one year there were thirteen granges and a State grange, with a membership of six hundred.

Mr. Hovey. It has all the advantages of the Farmers' Clubs in promoting improvement in agriculture, and its social advantages, embracing as it does the wives, sons and daughters of its members, were of the utmost importance.

E. B. True, of Newport, spoke briefly of the importance of more knowledge among farmers, and favored any organization that would promote it.

Mr. Jameson, of Irasburgh, made some remarks in regard to the evils of combinations among the industrial classes, and hoped that the farmers would, in their unions, avoid the mistakes of mechanics and operatives.

Dr. Hoskins thought that though the laboring classes might make some mistakes in the beginning, the tendency of the time, and indeed its necessities, led directly to the organization of labor as the only possible protection against the constantly increasing power and efficient organization of the money capital of the country.

Professor Collier expressed his belief that organization among farmers was not only inevitable but necessary, and

that as the products of labor should belong to the laborer, no other method was practicable for securing this except by united action. In the matter of prices, taken singly, the farmers are entirely at the mercy of the great buyers and the middle men; but united, they would be able to secure fair rates.

# AGRICULTURAL ETHICS.

A PAPER READ AT A MEETING OF THE STATE BOARD OF AGRICULTURE, AT BURLINGTON, JANUARY 25TH, 1872.

BY REV. JOHN NEWMAN, D. D., POULTNEY, VT.

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The term Ethics is comprehensive. It includes not only the science of human duty, but the body of rules drawn from it; as well the rules of practice in respect to single classes of human actions as in respect to human conduct in general. Hence we have a classification of the subject, as for example, political Ethics, social Ethics, and the theme of this paper, Agricultural Ethics.

Duties always arise from and grow out of relations. The moment relations are established, duties exist and begin to declare their imperative. Very many relations are common to all, and hence many duties are common to all. Of these I do not purpose to speak, much less would I pretend to construct a science of Ethics as applied to agriculture, or develop *in extenso* a system of practical rules for this particular department of human industry. This paper is confined chiefly to a few of the characteristic relations and duties of the agriculturist, and a few of the more common violations of ethical principles to which he is exposed.

1st. The agriculturist should consider his calling as appointed of God, and himself an ordained agent for supplying human wants, and promoting human happiness. In the

world's great work-shop there is work for every man, and every man is adapted for that work better than for any other. This duty, therefore, is not peculiar to any class of persons; and yet the farmer, more, probably, than persons of any other class, considers his business an accident, and himself the victim of a blind and undiscriminating Fate. This is the calling to which most men have been appointed both by the necessities of the race and the ordinance of God. The earth is the great depository of the materials and forces for supplying our bodily wants, so that it is no more true, that dust thou art, and to the dust shalt thou return, than that from the dust we live. "The Lord God planted a garden eastward in Eden, and there he put the man, whom he had formed, to dress it, and to keep it." Agriculture was therefore man's primitive employment, and had he not sinned, few would have been engaged in any thing else. The effects of the fall have rendered it still more necessary than before; for the earth was cursed for man's sake, and made to bring forth thorns and thistles. If in the sinless state it needed to be dressed and kept, much more now, that toil has been made the penalty for sin. But for sin, many of the trades and professions, in which a large portion of the human race is now engaged, would never have existed, and the multitudes, so engaged, would be laboring, with high purposes and holy feelings, to dress the earth and keep it according to God's original plan. Were it possible to turn into its legitimate channel all the energy now employed in pursuits which originate in man's depravity and sin, we should soon see the wilderness and the solitary place made glad, and the desert rejoicing and blossoming as the rose.

Horace propounded to his patron the question 2,000 years ago. "*Quo fit, Mæcenas, ut nemo, quam sibi sortem seu*

*ratio dederit, seu fors objecerit, illa contentus vivat?*" It seems to have been true, then, that each believed some other one's lot preferable to his own, and the fact has not materially changed, to the present time. While it is, perhaps, generally true that men are discontented with their lot, this discontent is manifested more by the agricultural class than by any other. While in the field of toil, and under a vertical sun, he thinks of the mechanic in his shop, or the merchant in his counting room, or the professional man in his office, and envies them the shelter under which they prosecute their work, even though their hearts are utter strangers to his freedom from anxiety, and their pillows never know the quiet slumbers which refresh him for his daily task. Contentment with one's calling does not imply indifference to progress and improvement. On the contrary the highest degree of improvement can only be secured where there is this contentment; for if a man be not content with his business, he will be constantly planning to change it for some other, and will not bestow upon it either the thought or the expense which possible and desirable improvements require. "All things," said the wise man, "are full of labor." All things have been so arranged as to render labor necessary. The door of true success opens to no magic sesame but labor. Labor and happiness have been divinely wedded, and what God hath joined together, man cannot put asunder. When a man is in his appropriate work, and pursues it with right motives and worthy feelings, he will find happiness in it, and have the constant satisfaction of acting well his part. Let the agriculturist look upon his business, not as an accident or calamity to be freed from as soon as possible, but as a work to which he is called; called by his adaptation, by the fitness of things; called by the wants of society, and by the providence of God; then will he find

contentment and happiness in it; he will attract to it some who now regard it as a pursuit to be shunned; he will do something to dignify labor, make it honorable, leave to posterity the heritage of a worthy example, and receive from all right-minded men the meed of praise, "well done."

2d. The agriculturist should not consider himself merely an agent to multiply material products with which to feed himself and others, and minister to sensual gratification. His own physical wants are so pressing, his relations to the earth are so intimate, and his products go by so short a route to the gratification of physical appetites, that he is constantly in danger of considering this the sole end for which he lives and labors. If the man who walks behind the plough and holds the handles, thinks only of the work to be done, the crop to be harvested and marketed, and of the physical sustenance and pleasure to be afforded to himself and others by it, wherein is he elevated above the ox, that walks before the plough, and ultimately shares with his master the product of their mutual toil? Dr. Watts said, with more satire than poetry:

> There are many of us creep
> Into the world, to eat and sleep,
> And know no reason why we're born,
> Save only to consume the corn,
> Devour the cattle, fowl, and fish,
> And leave behind an empty dish.
> The crows and ravens do the same,
> Unlucky birds of hated name,
> Ravens and crows might take their place,
> Devour the corn and carcases.
> Then if their tombstones, when they die,
> Ben't taught to flatter and to lie,
> There's nothing better will be said,
> Than that they've eat up all their bread,
> Drunk up their drink and gone to bed.

The agriculturist may pursue his round of daily work in multiplying material products, without regarding his calling

as an end, but only as a means to the high and noble end of improving the intellectual moral status of himself and family, and lifting his neighborhood to a higher plane of thought, and feeling, and purpose.

3d. The agriculturist should not aim to secure the greatest immediate results, unless they be, at the same time, consistent with the best and most permanent future results. As the prudent husbandman plants trees, whose fruit he may never taste, so he should build fences, houses, and barns, that will outlast his personal necessities, even though it be at an additional cost. He should never feel at liberty to do anything to serve the purpose only while he lives, saying, let the next generation take care of itself. Such a course inevitably impoverishes his soil, depreciates his property, demoralizes his family, and demoralizes himself most of all. As the statesman enacts laws, and the philanthropist founds institutions to benefit coming generations, so the agriculturist should do his work in such a manner that the work of his successor shall be one term of a progressive series beyond his, instead of reconstructing it from the beginning. Example is contagious, and the farmer who builds a sham house, because it is a little cheaper, and will afford him a shelter as long as he shall need one, will lead many others into the same folly, and inflict upon his family and society an injury, which the money saved, by his mistaken economy, can never repair. On the other hand, he who does his work, not merely for to-day, but for all time, as far as possible, who rears structures of the most thorough and substantial kind, and who pursues the most approved method, even at a greater present cost, sets an example which it will be safe to follow, and exerts an influence which will bless others even after his mortal hour.

4. The agriculturist should, both for his own happiness

and for the highest public interest, have a regard to the æsthetical influence of all his structures and methods. On many parts of his estate there will be calls and opportunities for the gratification and improvement of his taste. This will be a source of elevation and pleasure, not only to himself, but a means of education and culture to employees who execute merely the manual labor. Wherever two methods present themselves and one affords an opportunity for the exercise and gratification of taste, while the other does not, this opportunity should hold the casting vote even in favor of greater expense, and should not be sacrificed except to paramount duty. The educating influence of buildings, fences, fields, groves, lawns, gardens, and indeed of all the parts and appurtenances of a farm, may not be disregarded nor treated indifferently. Every member of the farmer's household, every person in the community, and even the stranger that passes by, but once it may be, has a right to demand not only that no violence be done to the principles of taste, but that his sense of the beautiful shall find some gratification. A field of corn with a given number of hills will produce no more bushels to the acre when the rows are straight and regular than when zigzag and irregular, but who does not look upon the one with emotions of pleasure and feel while looking at the other as though he were suffering some severe contortions of the body. A want of care in these respects will sooner or later lead to carelessness in more important ones, and the process will be likely to go on until the personal physical habits will be vitiated and the taint ultimately strike through to the soul. Mere utilitarianism might object that the expense is needless—that it makes no corresponding return of material result—that the gross products of the farm are just as great without this regard to the beautiful, while the farmers' physical wants

might urge their claims for supply first. The obligation of utility would be valid if man were only an animal, requiring but food, raiment and shelter, and the other objection would be valid if the intellectual and spiritual were subordinate to the animal, but since the intellectual and spiritual transcend all other wants and interests, it is a blind selfishness that leads the agriculturist to disregard æsthetical principles in his structures and methods.

A short time before the Savior was betrayed, and while he was in Bethany, a poor woman with an alabaster box of ointment came into the house where he was, broke the box aud poured the ointment on his head. The ointment was precious and the odor of it filled the house. One of the disciples, probably Judas, at once asked the utilitarian question, "To what purpose is this waste?" Judas was the father and founder of the utilitarian philosophy.

5. The agriculturist should guard against the narrowness and contraction which his calling is liable to produce. He cannot in consequence of his situation and duties mingle in society abroad as much as many other classes. His isolation is not favorable to a broad charity and to liberal doings. It seems to be a principle that we prize highly and part reluctantly with that into which our own exertions have entered. Where our accumulations are made in small sums, our distributions are made in like small sums On the other hand when our business familiarizes us with large sums and our gains are made in large sums, we more readily give in large sums. The agriculturist gets his money by the sweat of his brow more literally than any other class. There is, therefore, a philosophy in his clinging to it more tenaciously than others. His wealth is the result of small accumulations through a long period of years, as the glacier has been formed in the mountain gorge, so imperceptibly that he could not

perceive its growth, and being scarcely conscious of possessing any more than when he first began, he may not devise any more liberal things when he counts his money by thousands than when he counts it by units.

This narrowness and illiberality is often exhibited in his own community, where his highest interests would be promoted by generous expenditures. Country school houses and country churches are the proof of the almost universal truth of this position. The school houses in agricultural districts are generally perched upon some triangular ledge by the roadside, that is worthless for any other purpose, and on which neither shrub nor tree can be coaxed to grow, while the house itself might, but for its position, be easily mistaken for some inferior out-house of an agricultural establishment, and the grounds occupied in the daytime by embryo kings and queens, are occupied by peripatetic cattle at night. The houses of worship in the rural districts are generally the most grotesque objects the traveler beholds. Their apparent contempt for the beautiful, and their dilapidated, tumble-down condition, are an unerring index of the intelligence, the morals, the culture, the enterprize and the liberality of the communities in which they stand, and suggest their fitness for any other use, rather than places in which to preach glad tidings of great joy and illustrate the refining influence and blessed charities of the Christian religion. Because our Saviour was born in a stable we should not conclude that the places of his worship should never be any better than the place of his birth; nor should we, like the kings of Israel prior to David, be satisfied to dwell in palaces of cedar, while the ark of the Lord rests in a tent of skins.

6. There seems to be some influence exerted by agricultural pursuits, that disqualifies many men to make nice

moral distinctions and prevents them from being sensitive to moral obligations. This influence manifests itself more in small than in great things. Ordinary farmers, I have sometimes feared, were the last men that would swear to their own hurt and change not, and that they were the first who would violate a contract, when their interests could be subserved by so doing. Let me not be understood as slandering a class: this would be unjust. I only state the impression made upon my mind by a good deal of experience and observation. We do not look for large operations in fraud and plunder by men whose muscles are taxed by laborious industry, from sun to sun; but in their stead we are apt to find little deceptions, little frauds and little prevarications. This probably arises, in part, from the fact that the agriculturist is chiefly occupied with products, into which muscle enters largely as an element of value, and does not appreciate the extent to which brain enters, as an element of value, into the products and wares of others: hence he concludes that others have, to some extent, what does not belong to them, and that he is justified in equalizing, somewhat, the distribution. He toils from daydawn till twilight, while his mechanic and common laborer work their customary eight or ten hours, at compensating wages, and without any risk or anxiety in regard to crops or prices. He easily arrives at the conclusion that his services are entitled to a larger share than they get according to law, and the deficiency may be made up by varying weights and measures, without committing anything more than a venial offence. At any rate the farmer will need to resist the tendency to indulge such a feeling, lest the feeling cherished should blunt his moral sense, distort his perceptions of right and wrong, lead to the existence and indulgence of a wish, the wish become father to a thought, the thought ex-

cite a volition, and the volition result in a moral catastrophe, to which he has been led by imperceptible gradations, and in regard to the remote possibility of which he at first would have said, "is thy servant a dog that he shall do this thing?" So it is that "lust when it is conceived bringeth forth sin, and sin when it is finished bringeth forth death."

Every agricultural district has its men who are acknowledged leaders—representative men—who overcome all the adverse influences of their calling and are models worthy of imitatation in all respects. To such a sacred trust has been committed talents of influence to be improved. They are the guardians and conservators of intelligence, of patriotism and of virtue. And one of the most gratifying facts developed in our country's recent trying ordeal was, that whenever great and important questions were submitted to the people, they deliberated upon them carefully and settled them correctly: thus showing that however corrupt the controlling rings may be in the cities, the heart of the masses of the rural and farming districts is sound and can be trusted. Nor have we reason to fear that our liberties will be overthrown and our government subverted, until ignorance and venality shall spread their dark pall over our agricultural citizens. The duty, therefore, of the agriculturist, whom God has honored with position and influence, is apparent.

# METEOROLOGY.

A PAPER READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, &c., AT BRANDON, JUNE 8 AND 9, 1871.

BY REV. R. G. WILLIAMS, CASTLETON, VT.

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It is with a large amount of diffidence that I essay to present a paper on this subject, to a Board whose name implies it is mainly devoted to "Agriculture" (working the soil,) "Mining" (working under the surface of the earth,) and "Manufacturing" (working up the products of the earth for man's needs and to administer to his taste.)

I find, however, two sources of relief from this embarrassment. One, in the fact that a knowledge of what is above man, literally, and liable to come down unpleasantly upon his unsheltered head, has a decided bearing upon his pursuits of one or more of the particular kinds of the business named in the Board. If the farmer knew, that though the morning gave appearance and promise of a fair day, yet rain would surely come before night, he would not send his men into that meadow, or that grain field, to lay prostrate what would endure the storm so much better if left standing.

But a very few days since, some pleasure seekers in this vicinity were jubilant in the morning. Never was there a brighter one, or one less cloudy. They were sure of a bright, pleasant day. A meteorologist told them it would storm soon. *They* would not believe it; not a cloud was to

be seen. It *could not* rain before night. They went their way. Very soon the clouds began to gather. Cirrus streaks soon grew to cumuli. These packed together rapidly. About the time for lunch to the pleasure seekers, they were looking for a place, not in the shade, but to be safe from the rain which was soon coming. They did not need to go to the spring, for about half an inch of rain kept them from being very dry. The farmer would have attacked his hay or grain on such a morning, unless the warning of one who read other signs than any visible in the heavens, had been heeded.

I think the wisest of men in his prophetic character, or in his greatest wisdom, gave an early intimation that a knowledge of meteorology would have much influence upon the labor and special day's work of the agriculturist. Eccl. XI, 4. "He that observeth wind shall not sow; and he that regardeth the cloud shall not reap." The reaper does not put in his sickle when the cloud appears over him low and watery. If his eye can behold it in the distance through the glass which science furnishes, he will then regard it, and not go forth to lay his grain upon the earth, soon to be soaked by the rain of a swift coming cloud. Science has constructed a glass to read the clouds on other planets, to split up the materials of their formation, as found in their light. It certainly is not too much to expect that man can find as much in the atmosphere of his own planet, and that he can construct instruments to detect and enable him to codify its laws.

Another reason for venturing before this Board with a paper on this subject is, I hope this Board or another will have entrusted to it the gathering and preserving of the results of observations upon the atmosphere and connected subjects. It is becoming recognized more and more as

a subject worthy the attention of scientific men, and already have men, who think that whatever is not practical is useless and unworthy their attention, acknowledged the very practical and useful results thus far achieved, and are inclining to the opinion that perhaps there is something in it after all. From the very nature of the case, the investigation of the laws sought for cannot be the work of one individual. Therefore, it is proper that a Board, or Society, should have this subject under its charge. And this cannot be undertaken too soon. Observations covering our state, and extending through many years, may be necessary to furnish the data by which the laws of atmospheric waves, rain falls, evaporations, etc., etc., are to be discovered.

Another society is undertaking this for the nation, but it seems eminently proper that the State should foster such investigations, and aid in the advancement of science. The records of such observations should be kept safe from the chances of loss, so much greater if in the hands of a single individual.

The Creator of the world, having prepared it for man, placed him upon it and gave him dominion over it and all upon it. He brings it into subjection to himself, not by making laws for it, but learning the laws imposed upon it, causes its fidelity to its laws to work for him. He knows the falling water will never gravitate less reliably, or the elasticity of metal or of steam fail to turn the wheel whose motion depends upon that discovered law. He has long asserted his dominion over the earth. He is gradually acquiring absolute dominion over the waters under the earth; entirely so but for the waters above. Here, then, and the atmosphere containing them, is his last field for attaining the full accomplishment of his mission in the dominion given him.

If his commission included the whole, as so it reads, he

has a right to regard the atmosphere as a field for his investigations. He has the farther right to believe that he is to acquire this dominion, as he has his dominion elsewhere, by learning the laws of it. This compels the belief that the enveloping fluid of the earth is subject to law. This point reached, man's task is plain, though possibly more difficult here than in some other part of his realm. For this fluid kingdom is more unstable than the soils where he plants his seed, than the rocks whence he quarries his marble, than the water which turns his machinery or floats his ships. But he may not, therefore, infer that it is lawless, and so beyond his powers of research and of use. It is indeed an immense domain, but his commission is commensurate with it. Why, the very brute beasts have long since been telling men that there are laws which foretell the coming storm, and men have been content to be guided by the lower instincts of birds and insects, rather than show their greater nobility by using their reason to learn the lesson independently, and also to detect the signs ere they became patent to mere brute instinct.

Some surprise may well be expressed that this subject has not earlier elicited the careful attention of scientific investigation. But until the Torricellian tube (1643) and the thermometer were well established as reliable and accurate, little advance could be made. These investigations can then date no farther back than 1640. Even some years must then elapse before a system of observations would be commenced. Perhaps no one could certainly predict that those were the instruments by which the upper fluid would make the revelation of its laws and acknowledge its subjection to a creature so long standing in ignorance and awe of it. But man is master, and having discovered the key, applies it to the wards, throws back the bolt, and enters upon the explora-

tion of the long kept secrets. It is not surprising that he made at first but slow progress in reading a language whose characters were yet unfamiliar. He had read, of course, for ages, the meaning of some of the clouds, but he had also mistaken many other appearances as signs, till he had mottoed his belief in them, as "All signs fail in dry weather." But he has passed beyond those times of experiment. The weather-wise are becoming wiser, and a very good guess as to the weather does not exalt *one* alone to be the Sir Oracle of the village crowd. There was shown at the Paris Exhibition a barometer vastly more delicate than any before known, by which, it was claimed, storms were heralded eight or ten days in advance. With such an instrument the coming storm could be anticipated, as well as the locomotive whose low bellow had been heard in the distance.

It is thus seen to be a subject well calculated to awaken interest in every man. The student of nature finds here a vast field for research. The practical man of any profession may find something that bears directly upon his personal comfort and welfare.

If the atmosphere be subject to laws and man can discover them, we have made a great step on. Not hoping to control it, we can plan our business to make those laws our ministers and servants, rather than destructive of our industries.

The credit is publicly given to the United States of taking the lead and making the most progress in collecting a vast number of observations, and of deriving from them data sufficient to announce to the world the probabilities of the weather of the coming day. I believe it true to say, that in the writer's experience, those probabilities have become realities since their publication, in *every* instance with but two exceptions.

The laws of storms, as to their origin, their onward progress, their extent, are being subjected to crucial tests. The remarkable accuracy of these predictions gives great cause to believe that we are on the right track. A single storm upon some of our great lakes has caused the loss of $2,000,000, which could have been prevented had the present storm signals been introduced.

The storm which overtook Napoleon in his retreat from Moscow could have been foretold to him, and perhaps thereby would have been changed the map of Europe, certainly averted vast suffering and saved many lives. Nelson at Trafalgar profited by a storm, whose approach he noticed, but the enemy disregarded, and became so weakened as to be an easy conquest. Voyages and enterprises have been entered upon in untold instances which resulted disastrously because of a storm, whose approach could now be foretold. Individual cases of accurate prediction can be given for a period of forty years, but it is only within the last ten years that it claims a place among the sciences. The records of the first year, 1861-2, under Admiral Fitzroy's system of storm warnings, show that one-half of the warnings given were correct, and the second year 73 in every 100 were right. In 1864-5 and 1865-6, out of 100 warnings given, 71 in the first term and 76 in the second were true, and out of 100 storms which occurred, 89 were signaled the first term and 94 the second. The forecasting of storms now would give a larger proportion of accurate predictions.

In order to make them still more accurate there needs to be a system of careful and continued observations more local, so as to ascertain how far local causes shall come in, or do come in, to affect the general range and character of a storm, whose general outline, character and course could be accurately traced in advance. Mountains, plains, islands,

lakes, oceans and ocean currents, have local influence to retard, arrest, divert the course of a storm and somewhat to change its character, as from snow to rain, or the reverse, or from severe to lighter rainfall, or the opposite. Causes which increase the cloudiness of localities will also influence the amount of rain fall. Thus England has seven to ten more inches of rain per annum than France, and four to nine more rainy days.

The writer has taken record of the weather for twenty years with but little interruption, commencing with three observations per day. His interest increased, the value of them seemed to increase, the satisfaction of referring to data when it was desirable to know the weather of a certain day or season, all these led to an increased number of observations till they amounted to seventeen per day, which have been made and recorded for the last six years. These seventeen include only the thermometrical and magnetic needle observations. Those for the barometer, hygrometer, direction and force of wind, kind and amount of clouds, are made only seven times a day. Those of the motions and velocity of the clouds are made but three times a day. Supposing that the wind and rain would be of more interest than either of the other subjects, I have selected only those for notice at this time. Records of the thermometer are yet to receive more attention, and they will be found to have more value than has yet been supposed. They form a large part of the climate of the place, and the causes that effect the temperature of a region are also causes that operate to make that a desirable or unsuitable place for a man's home. Thus the development of a country, the prosperity of it commercially, its growth in population and wealth, may yet be accurately predicted by the thermometer.

The magnetic needle deserves a system of observations.

Its variations may be wholly terrestrial, they may be largely solar, there may be other causes. The magnet is an index pointing not only to the north star, but pointing out a path where the scientific traveler will yet pursue a course untrodden hitherto, but promising and eventually rewarding with results that may form a crown of glory to the successful seeker, and prove of vast benefit to his fellow men.

I do not propose to present results of observations taken elsewhere than in this state. These cover only a period of twenty months, commencing October 1st, 1869, and coming down to the 1st of this month. The period is too short to give of itself sufficient data to infer laws that would be regarded as well established. They are presented only as an humble contribution to the science which is now receiving much attention, and which even now promises to be of as much material benefit to man as any other. Indeed, it will not seem extravagant to some to claim for this science that it can do more to save loss of property and of life than *any other* whatever. A noble vessel, freighted with millions of property and hundreds of lives, going down in mid ocean, entails a positive loss so vast that whatever can be done to lessen it should receive the hearty co-operation of all classes. The loss to the English nation has averaged for several years more than one vessel per day. It is not, of course, claimed that all this loss can be prevented, but it is claimed, and the claim is already well established, that quite a considerable portion of it may be, not merely by delaying to set sail upon a voyage on the eve of an unseen but predicted storm, but also, when on the voyage, a captain, knowing the laws of atmospheric waves and currents, may guide in safety.

So dangerous has been the navigation on our great lakes,

that insurance companies have hitherto refused all risks after November, till the next spring. Now a storm may be foreknown, and the voyage deferred and property and life saved. It has been officially published that these storm signals "have been the means of saving lives and property to an immense extent." Our government and others are doing a most noble work in thus calling upon science to aid in the material prosperity of the country. It is only another instance in which pure science, scouted and despised by the mere toiler, has fulfilled the divine command "to do good to those who despitefully use and persecute you."

Upon removing to this State in September, 1869, I at once set up my instruments and commenced recording the observations. I use a thermometer graduated so as to be read to tenths of a degree; a barometer with vernier scale; a dry and wet bulb hygrometer; also one composed of some East India wood; a rain guage by which a thousandth of an inch of rain can be measured; a common magnetic needle and a dipping needle. Of the direction and force of the wind, and motion of the clouds, I use only my senses. I also use a self-registering spirit or minimum thermometer. I need no maximum, as observations are taken every hour during the day, and frequently at times between the regular hours. Most of the records are forwarded to the Smithsonian Institution, by which similar records from about eight hundred observers are made, and will be used in still farther reducing to a code the laws by which the currents, regular and irregular, are regulated. It is not too much to expect that ere long it can be as well known what winds are to be expected, what storms and where and when, as it is now what compounds may be expected from the combination of chemical elements. Nature is everywhere under law. Man is commissioned to subdue it. Observe and

learn her laws, and she will work for him. Disregard, and she punishes his ignorance and indolence.

*Table giving all the winds by hours, and their strength.*

| | N. | | N. E. | | E. | | S. E. | | S. | | S. W. | | W. | | N. W. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 A. M. | 2 | 45 | 29 | 46 | 23 | 24 | 117 | 181 | 12 | 21 | 127 | 216 | 58 | 72 | 89 | 124 |
| 10 A. M. | 25 | 43 | 8 | 12 | 9 | 14 | 21 | 36 | 13 | 17 | 95 | 154 | 31 | 34 | 58 | 89 |
| 12 M. | 40 | 62 | 22 | 35 | 7 | 14 | 65 | 118 | 10 | 14 | 184 | 343 | 67 | 94 | 127 | 188 |
| 2 P. M. | 54 | 85 | 16 | 28 | 6 | 10 | 63 | 110 | 16 | 35 | 190 | 349 | 94 | 142 | 125 | 224 |
| 4 P. M. | 12 | 29 | 9 | 16 | 3 | 7 | 30 | 54 | 5 | 10 | 31 | 61 | 5 | 10 | 20 | 33 |
| 6 P. M. | 49 | 78 | 23 | 31 | 18 | 24 | 59 | 97 | 14 | 23 | 134 | 201 | 74 | 108 | 101 | 136 |
| 9 P. M. | 71 | 79 | 38 | 56 | 30 | 37 | 56 | 101 | 9 | 13 | 86 | 136 | 43 | 58 | 80 | 109 |
| | 280 | 21 | 145 | 224 | 96 | 130 | 411 | 697 | 79 | 133 | 847 | 1460 | 372 | 518 | 600 | 903 |

**NOTE.—The record for 10 o'clock A. M. is only for 10 months, and that for 4 P. M. is for only 4 months. The first column of figures under each wind gives the number; the second column their velocity.**

From the observations of the wind some curious results are obtained, viz: Wind from the north increases quite regularly as the day advances from morning to evening, and this both in the number of times the wind blows from the north, and in its velocity or strength, *but velocity much less in proportion.*

| Thus, at | 7.00 A. M. | 10.00 A. M. | 12.00 M. | 2.00 P. M. | 4.00 P. M. | 6.00 P. M. | 9.00 P. M. |
|---|---|---|---|---|---|---|---|
| Times, | 26 | 28 | 40 | 54 | 90 | 49 | 71 |
| Strength, | 45 | 43 | 62 | 85 | 150 | 78 | 79 |

On the other hand, the south wind decreases from morning to evening.

| Thus, at | 7.00 A. M. | 10.00 A. M. | 12.00 M. | 2.00 P. M. | 4.00 P. M. | 6.00 P. M. | 9.00 P. M. |
|---|---|---|---|---|---|---|---|
| Times, | 12 | 13 | 10 | 16 | 15 | 14 | 9 |
| Strength, | 21 | 17 | 14 | 35 | 40 | 23. | 12 |

Winds from northeast, east and southeast curve in one direction, and those of southwest, west and northwest, curve in the opposite direction, that is, the easterly winds are more numerous morning and evening than in the middle of the

day, and the westerly winds are more numerous in the middle of the day than in the morning and evening. The result of all the winds gives the wind at 12 M. as much stronger than at any other hour, increasing more rapidly from morning to noon, than decreasing after that hour.

Our prevailing wind is the southwest. The southwest and southeast winds are of about the same velocity; the southwest exceeds the southeast in frequency, in the proportion of nearly 2 to 1. Compared with northwest the southwest is considerably more violent, and exceeds in frequency as four to three nearly. The southwest is about equal in number to both the northwest and southeast, and in aggregate strength nearly equal to them both.

The record of winds by months makes April the first in number, and July first in strength. October the most calm.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Jan., | No. | 136 | Strength | 186 | July, | No. | 160 | Strength | 326 |
| Feb., | " | 132 | " | 183 | Aug., | " | 120 | " | 231 |
| Mar., | " | 168 | " | 242 | Sept., | " | 154 | " | 188 |
| Apr., | " | 172 | " | 301 | Oct., | " | 107 | " | 170 |
| May, | " | 153 | " | 279 | Nov., | " | 112 | " | 171 |
| June, | " | 152 | " | 283 | Dec., | " | 137 | " | 185 |

There is quite a regular decrease in number of winds from April, in each direction to the minimum month, October. A similar decrease in strength from July, the month of strongest wind, to the same month, October.

The only other topic I have time to prepare or care to present at this time is the rain fall. This is to be taken with the direction and strength of the wind preceding and attending the fall. The fall of snow and rain should be studied somewhat independently. Rain and snow are formed upon different principles, or in different states of the atmosphere, but depend upon barometrical data.

The rain fall of a country is one of its most important climatic subjects, and vitally affects its value for man's abode. Theory has claimed that man has somewhat, and may have

very much, to do with the amount of rain fall in any locality. I have not yielded my conviction to the claim. Some facts afforded by observations, which cover longer periods than those claimed by some theorizors, do not sustain the theory. The laws by which the moisture ascends into the upper air are not under man's control, and when the moisture has gone up it will probably obey the boy's cry, when he throws up a stone, "What goes up must come down."

Of the 182 storms which have occurred during the twenty months of observation in this State.

| | | | | | |
|---|---|---|---|---|---|
| 4 | came with a | N. | wind, bringing | 2.050 in. | rain or snow. |
| 1 | " | E. | " | .489 | " |
| 3 | " | S. | " | .610 | " |
| 18 | " | W. | " | 4.510 | " |
| 18 | " | N. E. | " | 7.390 | " |
| 23 | " | N. W. | " | 15.505 | " |
| 48 | " | S. E. | " | 9.570 | " |
| 67 | " | S. W. | " | 11.433 | " |
| 182 | | | | | |

With the exception of that wonderful storm of October 1869, it gives the southwest as our stormy quarter, the southeast following closely in quantity of rain. The northwest has been largely confined to the winter months, they with March giving sixteen out of the twenty-three from that quarter, and the fall mostly in the form of snow. The month in which most rain and snow has fallen is October, which largely exceeds any other month. December follows next, but quite a difference.

| | | | | | |
|---|---|---|---|---|---|
| January | has an average of | 9½ | storms, giving | 1.447 | inches. |
| February | " | 9½ | " | 1.070 | " |
| March | " | 12 | " | 2.125 | " |
| April | " | 9½ | " | 1.322 | " |
| May | " | 9½ | " | 2.809 | " |
| June | " | 11 | " | 1.88 | " |
| July | " | 5 | " | 2.91 | " |
| August | " | 9 | " | .767 | " |
| September | " | 6 | " | .90 | " |
| October | " | 9½ | " | 8.760 | " |
| November | " | 6½ | " | 1.319 | " |
| December | " | 9½ | " | 3.817 | " |

The great excess found in October is accounted for by the special storm of 1869, which was 6.575, (for that month the one storm) giving more than an average for the month. The average per annum as thus observed is 29.119 inches, which is somewhat less than the average given to New England in other general tables. Seven of these months are very uniform in the number of storms, March and June giving more in number, but differing greatly in quantity of rain, while July, September and November fall very low, to 6½, 6, and even 5. This will tell its own story of that so much talked of "line storm," to avoid which so many plans are skillfully laid.

One other summary may be made to enable us to gather statistics. This is in reference to the direction of wind that brings the rain fall. The wind, for several hours preceding the storm, may have as much to do with it as that which attends the rain fall. Of about one hundred and seventy storms fully recorded, eighty-two were preceded by variable winds. Nearly a period of twenty-four hours was taken as the period of observation to note the preceding wind. The variation is sometimes very great.

The wind that brings the most storms is the same that attends the most, viz. the southwest. This has brought fifty-two, or nearly one-half of the remainder of the recorded storms.

The southeast is responsible for thirty-six and a calm for twenty-one. By counting in some other wind as a part of the variable, and also by counting only two, or even three, when the record gave each about equal value in causing or preceding the storm, we find that the north wind occurs twice, northeast eight times, east five, south four, west fifteen, northwest seventeen times during about twenty-four hours preceding the storm. These are too insignificant to

affect general results. When we observe the wind, therefore, varying frequently, it is just an even chance that there will be a rain. Then a southwest wind and a variable increase the chances three to one, and adding a southeast four to one. Casting out snow falls, which come largely with northerly winds, and the chances for rain from these become very much greater. Time to collate these records would enable me to give definite figures. Such as I have given, and the few attendant thoughts, have been very hastily collected and imperfectly arranged, or at least not so fully as might be done. Other facts could be gathered for presentation and a basis for generalization, and so for obtaining laws. For thus it is that man is to obtain knowledge of nature's laws. Then when known, he will find he can adapt himself to them, and make them promote his interests.

It is proper to add that other means are at hand to interpret weather signs and foretell storms. I have had time to notice but one. I have done this partly because the wind is present to the observation of every person—he needs no instruments to mark and measure this; partly because the record kept enabled me to give facts and figures quite as readily as the records of instruments; and again, partly because the records of barometer, hygrometer, &c., might not be clearly understood by some.

The thermometer has not been generally recognized as able to do more than record the temperature actually experienced. But in some instances it seems endowed with a true foreknowledge, and it makes a revelation to man of the future. With the forecasting of northeast storms the barometer seems to be less acquainted and disposed to aid. But now the thermometer comes to our assistance, and it is an exceedingly reliable index. The barometer and hygrometer, are, of course, largely relied upon for the foreknowledge

of storms. It is known to all that storms advance against the wind. The *overhang* of the storm is sometimes very considerable and gives its signs through all the heavens.

The clouds have long had names and characters, and have been pretty good indicators, and men think they know the meaning of cloud language. Observation has taught also that storms have *paths*. The cars keep upon their track. We take the road when we travel. So do storms. They have traveled the same road so frequently that we can know which way they will go next time. There are thus well-known highways. But if a storm "gets off the track," it cannot run wild and lawless. Two well-established laws now direct its course, and man's observation can tell where the storm will come. It requires, indeed, the telegraph, but man has that. The atmosphere is continually drifting about as the tides in vast waves of pressure. It will obey these two laws: 1. It will move from a point of great pressure, and so of a high barometer, to places of less pressure, and of a low barometer. 2. A region of aqueous vapor is a region of a low barometer. A comparison now by telegraph of hygrometers and barometers will tell which way the air wave will pass; this tells the wind, and this with accompanying indications tells the storm. And this can be done from two to twelve days in advance of the storm.

Winds have a character besides that derived from their direction. They may be warm or cold, wet or dry. This will have much to do with a rain fall in connection with them. Had time permitted, I would have made up the records, showing how many storms each wind had brought, compared with the whole number of winds from a given direction.

A heavy burden of other duties must be my apology for presenting a paper so evidently falling short of justice to a

subject so important. I can only hope that it will afford some evidence that it is a subject worthy the increasing attention of those who are seeking to promote the material interests of the state.

Replying to a question from Hon. P. W. Hyde, Mr. Williams stated, in reference to the published governmental forecasts, that in his neighborhood they had failed but twice since they have been sent out. This might not have been from real errors, but due to mistakes in telegraphing.

Professor Collier observed that some failures were undoubtedly due to telegraphic errors, and some to erroneous observations on the part of observers not having sufficient experience, not properly qualified, or negligent. Also to stations being sometimes subject to local influences, vitiating the value of observations. Making allowances for all these, the results have been encouraging in the highest degree.

# COPPER MINING IN ORANGE COUNTY.

A PAPER READ AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, &C., HELD AT BURLINGTON, JANUARY 24TH AND 25TH, 1872.

BY JOHN ROSWELL FARNHAM, BRADFORD.

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Copper ore was discovered and known as such as early as the year 1798 in the town of Strafford, in the southern part of Orange county. About thirty years later it was also found in considerable quantities in the southeast part of Vershire, the town next north of Strafford. And twenty years later a deposit of copper ore was found at Pike Hill in Corinth, which lies next north of Vershire. At these three places mines have been worked to some extent. There are indications of copper ore at various points on the same line with the three above mentioned, but not in quantities to induce the opening of mines.

The mines at Strafford and Vershire are about six and one-half or eight miles from the Connecticut river, in a direct line, while the mine at Corinth is twelve and one-half miles from the same river. They are probably outcrops of the same vein—if it can be said that there is a vein at all.

The three beds of copper above named are not in nearly a right line with each other, as is stated in the geology of Vermont, although they may range nearly with the strike of the rock or direction of the strata in that portion of the

State. A line drawn from the Strafford mine to that in Vershire, and thence to the Pike Hill mine in Corinth, makes an angle at the Vershire mine of about 155° pointing to the east, or opening to the West.

The character of the ores at all three of the places named is nearly the same. The copper ore is the yellow sulphuret of that metal mixed with iron pyrites or sulphuret of iron. In some places the vein carries a very much larger proportion of the latter ore than of copper.

The mine at Strafford has been wrought most of the time since its discovery for the manufacture of copperas, and as that is obtained from the sulphuret of iron, the process does not come under the head of copper mining, and is not entitled to mention here.

From about 1830 to 1839, copper mining was carried on at Strafford and smelting works were erected, but the business was found to be unprofitable and was abandoned. Afterwards in working deeper for iron pyrites to be used in the manufacture of copperas, richer deposits of copper ore were found, and in such quantities as to warrant mining for that metal. A new smelting furnace was erected, and during the early part of the war, when the price of copper was higher than ever before, reaching fifty-five cents per pound at one time, the business was pushed with a good deal of energy and was found profitable. At that time the company that worked the mine employed about one hundred men.

But when the war closed, and government not only had no use for copper, but threw upon the market almost two years' stock of that metal, and the shipyards of the country were silent, the attempt to mine copper at Strafford was abandoned—though there is no doubt that there are large deposits of copper ore in the town. All that is needed is capital and the pluck requisite in mining.

At the present time the Strafford mine is not worked for the copper ore alone, nor for the purpose of obtaining that ore to smelt; but the proprietors are now making copperas *at the mine*, and are sending quantities of both the iron and copper ores to Malden, Mass., to be used in the manufacture of sulphuric acid. This acid is obtained from the sulphur in combination with the iron and the copper in the sulphurets of those two metals.

So far as worked the copper ore in the Strafford mine seems to be in deposits or pockets as the miners term them, but when the shafts and adits are driven far enough into the earth the deposit will undoubtedly assume more of the character of a true vein, and the supply of ore will be more uniform.

In the town of Corinth there have been opened and worked two mines, to wit: that of the Corinth Copper Company and that of the Union Copper Company. They are both upon what is known as Pike Hill, and their entrances are within a few rods of each other. "The old mine," or that of the Corinth copper company as called by the people in the vicinity, has not been worked since March 1868, and a portion of one of the adits has caved in. This is the mine spoken of in the Geology of Vermont, and for several years, especially during the war, was worked with great hopes of profit, and dividends in the end; but in 1867 the product began to diminish, wages were high, the price of copper was low, and the expectations of even the least sanguine were disappointed. At the present time the buildings, including the miners' houses, are going to decay, the mine is getting into a condition that makes it dangerous to attempt to work it. The drills, boilers of the engines, crushing machine, and other personal property, have been sold

on execution at less than a tithe of their value, a portion of the real estate has been set off on execution to pay an attorney's fees, and the balance, including the mine itself, has lately been sold on a warrant for the collection of taxes, for an amount less than five hundred dollars. And as if this were not enough to discourage any further effort, one of the stockholders has brought suit against the company, laying his damages at the modest sum of eighty-seven thousand dollars, and put on an attachment over all the other incumbrances.

There is undoubtedly copper ore enough to be obtained from this mine, but the company will have to expend thousands of dollars before it can be made available. At the present price of copper, there is but little hope of this being done.

Since the above was written, a party in New York has taken a lease of the mine for ten years, and there is a fair prospect of its being opened again, the price of copper having gone up from twenty-six cents per pound to thirty-five.

The Union mine, as I have already said, is but a few rods from the "old mine." It is lower down the hill, upon the same vein. The entrance is, of course, on the land of the Union Company, and as real estate boundaries extend from the center of the earth to the heavens above, these mining corporations must each keep within the boundaries of the inverted cone or pyramid that belongs to it.

When this mine was first opened—in 1865, I believe—it was with a great blast of trumpets and gunpowder. Large excavations were made in the hill-side, many holes were drilled in the solid ledge and about a ton of gunpowder placed therein. When all was ready the whole charge was exploded at once with tremendous effect. The result of the

explosion was to throw out tons of rich ore, and bring to light one of the best deposits, or pockets, yet discovered.

This company seemed to be quite prosperous for several years, and, what is extraordinary in mining experience, it is said to have more than paid expenses for some length of time from the very first. The products gradually increased until they reached about two hundred tons per month, if I remember aright, and at one time exceeded the amount produced by the "old mine." Those were the days of prosperity for the Corinth and Union mines, and their success gave life to all the business of the town. Almost all the farmers in the vicinity took small jobs of drawing ore to the R. R. depot at Bradford on the Passumpsic road, whence it was sent by rail to tide water and thence by vessels to various smelting works in the country. The distance to the railroad is about thirteen miles, by a road descending all the way, so that a team of six horses or mules can easily draw five tons of ore to the load in good going. A copper miner's ton is two thousand three hundred and fifty-two pounds. In those days of success, as many as fifty horses, in a single day, have passed through Bradford village to the depot, in teams of from one to six horses, drawing from one to five tons of copper ore to the load. The regular contractor's or the company's teams drew most of it, but $3.25 per ton cash for freighting the ore to the depot was a temptation to every man who had a spare day with his team, and consequently many of the neighboring farmers drew ore for the companies. For a time employment of this kind was abundant, for the product of the mines was increasing and the regular ore teams had more than they could do. In those days of greatest prosperity the two companies employed over two hundred hands, and these men with their families were to be supported in a portion of the country

sparsely populated and with few conveniences for obtaining provisions or other necessaries. This made a good market for everything the farmers in the vicinity could raise, and everybody made money but the companies that owned the mines, and the towns that were compelled to build and keep in repair the roads over which passed the heavy teams laden with ore.

But all is now changed. Pike Hill is almost as quiet as before copper ore was discovered there. The miners have nearly all moved away, their houses are empty, and the engines and crushers have ceased their labors.

The Corinth Copper Company stopped work in 1868, as I have already said. The Union mine, suffering from the enhanced cost of labor and the low price of copper, and possibly from their vein getting pinched, (for miners don't mention such drawbacks till compelled to,) is now as silent as the "old mine," with the exception of three or four men that the superintendent now has drilling and blasting in a new direction, with the hope of striking the true vein. For your miner is a man of hope. He is always going to strike something. When he gets through to the *true vein* there will be rich deposits of ore and dividends for the stockholders. No man can be a true miner without a development of the organ of hope that would astonish a professor of phrenology. The superintendent of the Union mine still has hope. The superintendent of the "old mine" had hope, and between them and the hopeful officers and directors of the companies, they succeeded in infusing some hope into the hearts of stockholders for a time. *They* had hopes of dividends, but alas! for them, their dividends have always been assessments. For every ton of ore the stockholders have seen come out of the mine worth thirty-five dollars,

they have seen fifty dollars or more of hard cash sink into the same hole, where now the solitary clink of a single pair of sledges makes resound the damp caverns, mournful with the old story that hope deferred maketh sick the hearts of New York capitalists.

I have seen no reports of the products of the Union mine. I think they have never printed any, and consequently I can give no statistics.

The annual report of the Corinth Company for the year ending April, 1864, gives some facts of interest. Actual work on the mine commenced in August, 1863, so this report is the first one made. At the time of making it the company were employing fifty-two men and boys. They have mined three hundred and sixty-nine tons of ore, probably about ten per cent. ore, or a little less. Of this amount they have sold to the Baltimore and Cuba Smelting and Mining Company two hundred and forty-four tons for $12,742.88, and have on hand one hundred and twenty-five tons worth $6,006.25, making the total value of the product of the mine from August, 1863, to April, 1864, $18,749.13. The ore sold brought $53.75 per ton on an average; but the per cent. of copper is nowhere given. It cost considerable more to mine this ore than was received for it. The main shaft had been sunk about eighty feet, and an adit had been driven about one hundred and twelve feet.

From the report of 1866, or the year ending January 23d, 1867, we learn that the company mined during the year seventeen hundred and fifty-five tons of eight and one half per cent. ore, being about one hundred and fifty tons per month. They sold eighteen hundred and forty-four tons for $66,583.00 at prices varying from $19.89 per ton to $40.80 per ton, or an average of a trifle over $36.00 per ton.

During the year they had driven adits and sunk shafts five hundred and eight feet in all.

The treasurer's report for the year shows, as do his other reports, receipts from that most onimous source, assessments. He further says that the company have at the depot in Bradford five hundred tons of ore, worth at last year's prices $15,000. He adds that the indebtedness of the company, aside from salaries, of which none have been paid for the past three years, is also $15,000. It is wonderful how easily debts can be balanced on paper. During the year the company employed one hundred and seventeen hands. The same hopeful spirit pervades the reports of both these years.

The president says in his report in 1864: "The Board of Directors feel satisfied that no copper mine yet discovered can exceed the Corinth in its abundance of rich ore, feasibility and cheapness of working and drainage."

The mining captain, in his report for the same year, says, in speaking of one of the drifts: "It is certainly the richest and most productive drift I ever saw, in this or any other country." In the report of 1867, the same mining captain, speaking of certain branches of the vein of ore, says, "These branches of the late discovery in No. 2 adit produce good, healthy looking ore, but not in sufficient quantities at present to pay. Yet the indications will justify any practical miner in the opinion that these branches will unite in *the depths.*" Those branches of ore may have united in the depth, but the pocket of the Corinth company was not deep enough to enable them to find that productive depth.

These two mines are valuable property, and some day will add greatly to the wealth of Orange County and of the State, but they will have to be in the hands of men who have

the capital that will enable them to wait till the mines are fully developed before they can hope for permanent profits. Both mines ought to be owned by one company and under the same management, for the two are really but one mine. There have been some efforts made to bring about a consolidation of the two, but nothing has been accomplished yet. Should this take place and the price of copper continue as favorable as at present, the mines will be opened again and Pike Hill will again resound with the sledge and blast of the miner.

It now remains to speak of the mine of the Vermont Copper Mining Company in Vershire. This is the only copper mine in Orange County in operation, and one of the few in the whole country. It is, perhaps, the only one, except three on Lake Superior, and these would have stopped long ago did they not produce native copper, and so are independent of the smelting furnace.

The stockholders of this company are mostly business men of New York City. The President, Hon. Smith Ely, owns about sixty-seven thousand shares of the one hundred thousand shares of the capital stock of the company. F. A Palmer, President of the Broadway Bank, owns a large number of shares and is one of the Directors of the Company. I speak of these men because it is due to their energy and courage in risking capital that the company has stood through the misfortunes that have broken down other companies, and is now at work doing a large and I trust a profitable business. President Ely has spent nearly all of his time for the last seven years in looking after the affairs of the company, and more is due to him than to any other man for the present prosperous condition of the company's affairs.

The strike of the vein on which this mine is situated, taken as a whole, is nearly north and south; but the vein is

not straight. The dip or angle the vein makes with a horizontal plane is towards the east, and for the first three or four hundred feet from the surface is about 30°, but for the last few hundred feet that have been worked it is only 23°, as I am informed by Captain Pascoe, the present mining captain. The descent by the main shaft, which is on the vein, is so gradual that one can as easily walk down on the ties of the tram-way, as down a pair of stairs.

The principal work of the mine is done by excavating the rock on both sides of the main shaft on the vein, wherever the ore promises to make it profitable. This is called *stoping* in distinction from running an adit or sinking a shaft. It consists in taking out the ore in successive offsets or stopes, not, however, in the ordinary position of a staircase, but as though it were laid upon its side, or at some angle varying from that as the position of the vein may require. This enables several gangs of men to work at the same time without interfering with each other, and the captain more easily to measure and set out the work.

The shafts are the perpendicular or nearly perpendicular openings cut into the solid rock, and crossing the vein at different angles according to its dip, or in some cases, as in the mine under consideration, running with or upon the vein itself. The *main shaft* is the principal one of these openings, reaching from the surface of the earth to the bottom of the mine, and through which all the products of the mine are raised. Drifts are horizontal openings or passages from the hill-side to the main shaft, or from one part of the mine to another. Adits are drifts above the water level.

Work was commenced on this mine prior to the date (1853) of the charter of the present company, by Col. Binney, of Boston, and Isaac Tyson, Esq., of Baltimore, Md., at the top or lead of what is now the main shaft. A cross-

cut adit was also commenced by them near the foot of the hill, and driven in horizontally ninety-four feet, and abandoned, without striking the vein. It was afterwards ascertained that this work was abandoned when within four feet of the coveted prize.

Since 1854, when the present company commenced work, the main shaft has been pushed down on the vein, until now it has reached the depth of nearly nine hundred feet from the surface, and a new adit has been opened, higher up the hill than the abandoned one, which has been driven in till it reaches the main shaft, a horizontal distance of seven hundred and seventy-eight feet. The adit strikes the main shaft at a point about three hundred feet below the surface. A stationary steam-engine stands at the junction of the shaft and adit. A track extends from the bottom of the main shaft, up its inclined plane of from 23° to 30° dip, thence out through the adit to the outer world. The products of the vein all pass over this track. The engine draws the car laden with ore up to the level of the adit, and thence a horse, of long experience in the business, draws it to the outside of the hill, where a continuation of the same track takes it to the dressing house at the foot of the hill, a distance of about eleven hundred feet.

Work has progressed in all directions from the main shaft on the vein.

Usually one of the heaviest items of expense in mining is the drainage. But the rock in which this vein lies is so firm that there are but few cracks or seams to allow the admission of water, and the expense of draining has always been slight. The apparatus for doing it is simply a water tight car holding several hogsheads, into which the water is dipped from a reservoir blasted in the rock near the bottom of the mine. A few trips per day of this car drain the mine.

In 1854 the company mined one hundred and thirty-four tons of ore, and the product increased till in 1862 it amounted to twenty-two hundred and twenty-four tons. In August of that year, the company made their first dividend of $10,000, or two per cent. on the nominal capital stock. Dividends of the same amount were made once in three months till five had been made. The president loaned the company $10,000 with which to make the last dividend. The stockholders were long before familiar with the subject of assessments by practical examples. Soon after the payment of the last dividend the product of the mine began to diminish, till in December 1864 it was but forty-seven tons. For nineteen months prior to that date, the mines had not paid expenses.

In the early part of the year 1865 there was a good deal of fault found with the officers of the company and their management of its affairs. It was claimed that Captain Glonville, who for a year or two had been mining captain, did not understand his business and that he had lost the vein. The product had been diminishing as above stated, and the last month's product of forty-seven tons had been mined at a loss of three thousand dollars.

At the election of officers in January 1865 the obnoxious officers were removed and the present managers were placed in control. Captain Thomas Pollard, who had formerly been mining engineer, was restored to that position, and Captain Thomas Pascoe was put in charge of the work under ground as mining captain. These men that we have mentioned are all Cornish men and old miners in the copper region of Cornwall, England.

Pollard said that the main vein lay to the west of, or underneath the branch that Glonville had been at work upon and parallel to it. To reach the true vein was of course the only salvation of the company. He claimed there was a

fault, or heave, as he termed it, in the vein, and Glonville had been misled by a slight branch. A *horse* stood in the way, as the Cornish men say, meaning a dike, I suppose.

While the miners were quarreling about false and true veins, horses of rock and saddles of ore, the officers and stockholders of the company got by the ears, and began to sue and enjoin one another in a vein that proved a rich deposit for the lawyers, and might have proved fatal to the interests of the company, had not the plucky new president stepped into the breach and bought out all the quarrelsome stockholders, at an outlay of nearly two hundred thousand dollars. Before this was done, however, Capt. Pollard, in pursuance of his theory, cut through the foot wall or floor of the main shaft, in four different places, and the result was just as he had predicted. At one point he struck a large and rich part of the vein in going four feet, and at the other points he found the vein in cutting a very short distance. The main vein or deposit was underneath or west of the main shaft, which had been supposed to be on the vein. The product of the month of January, 1865, in which these cross-cuts were made, was one hundred and four tons of ore, and the amount continued to increase, until in 1867 it reached five hundred tons of ten per cent. ore per month, and the product at the present time is even more than that.

This new deposit, thus fortunately struck by Capt. Pollard, was in some places seventeen feet thick, and bore some resemblance to a simple bed or pocket of ore, but it was an immense one. From this point the company have *stoped* north nearly as far as their property extends, have gone somewhat to the south, have pushed the main shaft down or towards the east, and have worked the under or parallel shaft upwards or towards the west, and in all directions

they find ore. They are also working on the bed of the adit. The supply seems inexhaustible.

The pure ore, sulphuret of copper, contains about thirty per cent. of copper, but the material that is blasted and removed from the mine, taken as a whole, contains only about *three* per cent. This mass is made up of the rock in which the vein lies, iron pyrites, or mundic, as the miners term it, and the copper ore itself. The coarser mass of worthless rock is thrown aside at the mouth of the mine, while the rest is taken to the dressing house, where it is broken and separated, and the ore assorted so that when fitted for market it contains about ten per cent. of copper.

There are employed under ground about one hundred and fifty men. Work is kept up all the time by different gangs of hands. Night and day are unknown a thousand feet under ground. The feeble glimmer of the miner's lamp barely serves to make the darkness visible to eyes unaccustomed to such intense blackness, made dusky and more impenetrable by the smoke from the frequent blasts.

At first thought this business would seem to be unhealthy, but I am satisfied that it is not so to any great extent. There are no foul gases generated in a copper mine, like the fatal fire damp of the coal mine. With fair ventilation, the smoke from the powder used in blasting is soon removed. At one time, several years ago, the workmen were troubled by the accumulation of carbonic acid gas. There was then but a single shaft, and this poisonous gas gathered in dangerous quantities at the bottom. The men began to fall sick at the stomach, and some boys vomited and fell down. The older miners understood at once the trouble, and, shouting for all to follow, started for the open air. Some were generous enough and had strength sufficient to help the fallen, until they were met by fresh men who came in at the risk of

their lives, as miners will always do, and relieved them. One man carried a lifeless boy, not his own, until he himself fell down, choked by the fatal vapor. Fortunately none lost their lives. After this for a time the mine was worked only nights, when the cool, pure air of the evening, settling into the deep shafts, drove out the warmer, poisonous air. Capt. Pollard, as soon as he came, devised an ingenious and cheap plan for ventilating the mine, which was in use until the two nearly parallel shafts obviated the necessity of any such contrivance. He made a long wooden tube, a foot square, reaching from the bottom of the mine to the mouth of the furnace or fire-box or steam-engine, and thus produced a draft that thoroughly ventilated the mine, and there has been no trouble since.

The temperature never changes at such depths, and it is impossible to get an old miner to work in the open air in the heat of summer or cold of winter. He prefers the even temperature under ground. Miners have not the brown complexion given by the rays of the sun or the winds of March. But their countenances are ruddy, clear and healthy. And no Vermont woodsman swings his axe with the vigor and true aim with which the Cornish miner wields his sledge. In the mine, among its anomalies, three men are called a pair, meaning a pair of strikers and one man to hold the drill. It is interesting to watch such a pair at their labor. The small miner's lamp, set upon a stake or fastened against the wall with a lump of clay, sheds its faint light upon the top of the drill, which the alternate strokes of the heavy sledge drive rapidly into the softer vein of ore. The holder turns the drill between the strokes. To one looking upon these workmen for the first time, the danger to which the holder's hands are exposed seems so great that he involuntarily cringes at each stroke. But such accidents do not

happen. Miners never miss a stroke, and the aim is just as true and the stroke as sure when the drill is being driven vertically through the hanging wall as when going directly down through the foot wall, or in a horizontal direction, for the drill is driven in all directions and at all angles. This continued use of the muscles of the arms and shoulders makes the miners broad shouldered and deep chested, and gives them wonderful strength across the loins, while their lower limbs suffer from want of exercise and are not developed to the same Herculean proportions.

The miners work, some of them by the day, but most of them on shares, or "on tribute," as they term it. After the *stoping* ground is prepared by the company, the miners make a contract with the captain of the mine to take out the ore for a certain share of what it may be worth when it is ready for market. Whatever the miner's hopes may be at this time, he conceals them and drives as hard a bargain with the captain as possible. And as the miner has been at work upon the ground all the time he is in a condition to better judge what profit a certain number of fathoms of rock will pay than the captain, unless the latter thoroughly understands his business. The miners simply perform the labor; the company furnishes drills, sledges, lamps, oil, powder and fuse. Lucky tributers have made as much as one hundred dollars per week in the Vermont mine, though the average earnings of experienced miners does not vary much from two dollars per day.

The rock and ore are all removed from their places by the force of gunpowder. The Vermont company are now using about seventy kegs, of twenty-five pounds each, per month. With this amount of powder they remove on an average about fifteen hundred tons of rock per month, or

about eighteen thousand tons per annum. This amount is reduced to about six thousand tons of ten per cent. ore.

About half the amount now mined is hoisted from the bottom of the mine by the stationery engine, and then drawn out through the adit, and the other half is taken out from the vein nearly on a level with the adit and thus the expense of hoisting is avoided. The same car that brings the ore from the bottom of the mine runs down the inclined plane by its own weight to the dressing house, where the ore is fitted for the market or for smelting. It is dressed by being broken into pieces about the size of a small butternut, and the good is separated from the cheap or waste ore by hand. This work is done to a great extent by boys, and they attain a remarkable degree of skill in it. They will dress a mess of ore to any required per cent. The finer portions of the ore, that cannot be economically separated by hand, are washed or separated by water, the heavier copper ore sinking to the bottom, and the lighter rock and iron pyrites being washed off. From the dressing house the ore is taken to the railroad depot, if designed for market.

At present there is no market for copper ore. The smelting furnaces at Point Shirley near East Boston, at Bergenport, N. J., and at Baltimore, Md., where formerly the ore from the mines in Orange County was smelted, are all closed. The furnaces of the Vermont company at Vershire are the only ones in the whole country that are doing any business, except Crocker's smelting works in New Bedford, Mass.

About five years ago the proprietors of the Vermont mine, thinking that they might more profitably smelt their ores than to sell them, erected six blast furnaces for that purpose, and have kept them in operation most of the time since. The ore of this mine requires no flux, and the company are independent in this respect. The richer foreign

ores, the carbonates, that the Baltimore and Cuba Smelting Company worked when their furnaces were active, could not be smelted without ore from these mines, or of a similar character, as a flux. At one time that smelting company paid more for Orange County ores, to be used as a flux, than the copper they produced was worth.

When copper ore was prepared for market it was dressed to nine or ten per cent., that is, the mass of ore sent to market contained that per cent. of copper; but now that the ore is smelted at home it does not require to be dressed to so high a per cent. It is more economical to smelt it at six or seven per cent.

Since the erection of the smelting furnaces the dressed ore is taken from the dressing house to the roasting beds along a tram-way which runs upon trestle work over the beds, upon which it is dumped with little labor or expense. The process of roasting is very simple, not unlike the burning of a coal-pit. A layer of wood, less than a foot in thickness, is placed over the ground the size of the required bed. Above this is placed the coarser ore to the depth of four or five feet. After these piles of ore are built in the proper shape, the whole is covered with a layer of fine ore, in the same manner and for nearly the same purpose that the primitive coal pit is covered with earth. There are usually about three hundred tons of ore in a pile. After being prepared in this manner the wood is set on fire at each end and gradually the whole mass of sulphur contained in the ore ignites to a partial extent, though very slowly, and long after the wood is consumed the process goes on. It usually takes about three months to roast a lot of ore, and the company have from two thousand to three thousand tons undergoing the process, all the time. This operation drives off about twenty per cent. of the sulphur, in the form of sulphurous

acid gas, though the mass of ore weighs no less than when the process commences. This is doubtless due to the absorption of moisture by the ore during the three months of exposure to the weather. For some reason the roasting can be better and faster done in winter than in summer. The gases that arise from this process destroy vegetation in the vicinity and must be unhealthy for man. There also arise, during the roasting process, fumes of arsenic, small quantities of which are found mixed with the other ores.

At one time a proposition was made to the company and some experiments were made to roast the ores more rapidly than by the method above described. A party proposed to erect furnaces for that purpose, with the design of saving the sulphurous acid and of using it in the manufacture of sulphuric acid and various fertilizers. The proposition looked very feasible for a time and promised to be profitable to all parties concerned, as well as a great benefit to the farming community in that part of the State. But it turned out to be a humbug.

After the ore is roasted, as above described, it is taken by a car along a continuation of the same track to the smelting furnaces abuut a fourth of a mile distant, and is landed at the feed door of the furnaces. The car runs upon a platform on a level with the mouth of the furnaces and discharges its load without the use of the shovel. There are six of these furnaces in a slate covered brick building, sixty-two feet wide and one hundred and two feet long. Three of the furnaces blast at a time, night and day, for a week, while the other three are cooling off and being re-lined with fire brick and thus prepared for another week of terrific heat. The fuel used is coke, which is thrown into the furnaces in layers alternately with the ore. The coke is consumed while the whole mass of ore, rock and metal, is reduced to a liquid

by the intense heat produced by the blast, and gradually settles to the bottom of the furnace. When a sufficient amount of this melted material has accumulated, a hole is drilled in front and the liquid is allowed to run out into a cavity made in the sand. As this cavity fills up the metallic portion of the molten mass, containing the copper, settles to the bottom, while the melted rock or slag floats upon the surface and overflowing runs off and is thrown away. These metal materials are all of the same brilliant hue, but the slag does not flow as readily as the metal, and the workman easily marks the difference. As soon as there is a sufficient accumulation of the metal containing the sought for copper at the bottom of the sand pit or crucible, an iron rod is thurst though the side near the bottom and the contents drawn off till nothing but slag or dross remains, when the outlet is plugged up and the sand pit fills up again from the furnace. The metal flows out upon the surface of the ground made smooth for that purpose and cools in a large sheet about an inch in thickness. This is called mat or regulus, and contains about forty per cent of copper.

The melted material is flowing from the furnace all the time after it is once started, and the mat is drawn off as often as occasion may require. This process goes on till the furnace lining of fire brick is burnt out, or for a week. At this stage of the process one hundred tons of ten per cent. ore are reduced to twenty-five tons of mat. This still contains a large amount of sulphur, as well as iron and rock. The mat is now broken to small pieces by sledges, and taken to the roasting *kilns*. These look like a series of horse stalls on each side of the kiln-house, separated by brick partitions, each kiln having a grate at the bottom. A little wood is placed upon the grate, and the broken mat is placed above and roasted, in a manner somewhat similar to

the first process, though for a much shorter time. This is repeated three times. Seventy-five per cent. of the sulphur contained in the mat is thus driven off. I need not assure you that there is a *flagrant* odor of brimstone in a building containing twenty or more of such kilns.

Notwithstanding the amount of sulphur thus dissipated, the metallic mass is said to weigh the same as before being roasted this second time. The metal now contains sixty per cent. of copper. This sixty per cent. metal is again taken to the furnaces and melted as before, and the dross or slag allowed again to flow from the surface of the fiery mass. After the slag has run off to a certain extent, the workmen dip off from the top the impure and lighter metal, and send it back to go through the process again, while they leave at the bottom of the sand pit nearly pure copper in a melted state. The copper is then dipped into iron moulds containing about two hundred and twenty-five pounds each, and thus we have pig copper, ready for market, and in this form it is sold by the Vermont Copper Mining Company. It is about ninety-five per cent. metal, and requires another process to refine to make pure or ingot copper.

The furnaces of this company are now turning out one hundred thousand pounds per month, of pig copper, or fifty tons, of two thousand pounds to the ton. This is now (January, 1872,) bringing twenty-six cents per pound, and finds a ready sale. Thus the product of the mine is about $26,000 per month, or over $300,000 per annum. (Since writing the above, the price of copper has been up to thirty-five cents per pound.)

There are employed, in all, about the mine and works, three hundred men and boys. These, with their families, make a village of nearly one thousand persons. The miners are not the most desirable population, in some respects, but

they are hardy laborers, and usually temperate. They have lately built a Methodist and a Catholic church, and government has established a new post-office there, named Ely, from the president of the company. Very much of the success of the company, since they began to smelt their ores, is due to the skill and business tact and energy of Wm. H. Long, Esq., and his brother, Daniel Long, Esq. These gentlemen were for years connected with the Revere Copper Works, at Point Shirley, and thoroughly understand the business.

The mine and works connected with it are about eight miles from the station on the Passumpsic Railroad, and the Vermont Company employ half a dozen six-horse teams all the time in drawing fuel from the station and returning the product of the mines.

Two years ago the company experimented some with peat as fuel. They became satisfied that they could smelt with it and expended several thousand dollars in erecting buildings and the purchase of machinery and in the manufacture of peat. But the bed of peat that they commenced on was so small that it soon gave out and the experiment was a failure as to profit. But it was demonstrated that all the processes of smelting may be carried on with peat, and some of them to a much better advantage than with any other fuel. It must be caked to drive out the gases before it can be used in a blast furnace. That can be easily done in kilns of brick built for the purpose. The peat that the company manufactured cost them much more per ton than it would had there been an abundance so that the manufacture could have been continued long enough for a fair trial. The question of fuel and its transportation is to settle the success of the undertaking.

The present condition of affairs connected with the Ver-

mont Copper Mining Company look flattering indeed. But how long this will last no one can say. The vein may run out, the prices of copper may be down. It is three years since a dividend has been paid, and there have been but six in all, amounting to $150,000. Five were paid in 1862 and 1863, of two per cent. each, and one in 1869, of twenty per cent. (Since this article was read at Burlington there has been another dividend of six per cent., yielding $30,000.)

The nominal capital of the company is $500,000, divided into one hundred thousand shares of five dollars each. Some of the stock cost its owners less than a dollar per share. To them, if they have never paid assessments, the dividend of 1869, twenty per cent. on the par value, or one dollar per share, was on the whole quite remunerative and must have been satisfactory. But the trouble is that is the only one of the kind. Others of the stockholders have paid nearly the par value for their stock and assessments besides. To them a delay of from three to five years between dividends is rather tantalizing.

I speak of these matters because the question of copper mining, as of other mining in Vermont, is simply a matter of dollars and cents. If parties carrying on that business can make it profitable, they will prosecute it; if not, they will abandon it. The first question with New York capitalists is—"What dividend will it pay?"

I have thus in a very crude manner stated some of the bare facts connected with copper mining in Orange county. Very much more of interest might be said and ought to be on an occasion like this. What I have written has been in the intervals of business and in a limited time, and only serves to hint at some matters of interest east of the mountain.

# CHROMIC IRON OF VERMONT.

A PAPER PREPARED FOR THE MEETING OF THE BOARD AT NEWPORT, AUG. 6TH AND 7TH, 1872,

BY HON. E. P. COLTON, IRASBURGH.

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The existence of this mineral in the serpentine ranges of the Missisquoi valley has been known for several years. Fragmentary masses were first found on the surface, and in drift, but the quality of the ore was not determined until the late Prof. Adams was in the valley, during the progress of the geological survey of the State. It was first found in place, in the eastern part of Jay, at which point two openings were made, and several tons of ore taken out and sent to England. This ore was found to be very rich, and the parties who owned the deposit anticipated splendid results when the property should be developed.

The ores at this place are found in imbedded masses, and have no distinct veins, or lodes, and may be seen for two or three miles out-cropping in the serpentine ledges, in pockets containing from a few pounds to several tons. Very much of this range of rock is covered with timber and soil, so that there are but occasional out-crops where the ores, if any exist, can be seen. Some of these ores were taken to the smelting furnace at Troy, and, because no metal resulted from the smelting, the ores were pronounced manganese. On the hill, north of Mr. Kennedy's, near the village of

South Troy, and near the specular iron bed, chromic iron was found by the miners and thrown away as useless. Good specimens may now be picked up there which look as fresh as when taken from the bed. No effort has been made to mine this ore at that place, so that we are unable to say how the ores are deposited in the rock,—that is, whether in layers, pockets, or lodes. Very much of this range is covered with timber and bushes, so that if extensive quantities are deposited there, they are now unknown.

On a serpentine bluff half a mile from the village of South Troy, on land owned by Mr. Smalley, was an outcrop of chromic iron, which was discovered several years since, but was not worked till the summer of 1871, when fourteen tons were taken from that locality. The rock composing the bluff is a chloritic serpentine, having an irregular stratification or rift, traceable in a northeasterly direction from the face of the cliff. The out-crop of the ore may be traced some distance along the ledge, appearing in irregular masses of all shapes, usually along and in the seams of the rock. The deposit has been worked but a few feet from the surface, the ore appearing to run out, so that there are but three or four places where it is seen, and there it is in masses of from two to four inches thick and from one to four feet long. These ores appear in masses or pockets, and not veins or lodes.

In the town of Westfield, on both sides of the river where the serpentine ranges crop out, the ore has been found, and during the summer of 1871 over one hundred tons were sent off. On the east side of the river, on land owned by Mr. Bryant, over forty tons were taken from one place. Here the rock is pure green serpentine, having asbestos and picrosmine in places along the range. The excavation for the ore has been made but a few feet into the

rock, the ore having very much the appearance as at the places above described. The range between this place and Smalley's, at South Troy, is covered with timber and small shrubbery, so that it is impossible to make any examination, but there are in all probability occasional out-crops of the ore between the two points. On the opposite side of the river, on land belonging to Miller, appears an out-crop of the ore which is about two feet square, and a short distance west on the opposite side of the highway it appears in a seam of the rock. About one hundred rods south and west of the highway the range rises so as to form a hill fifty or sixty feet high, having on the westerly side a mural front extending for ten or twelve rods, which is from twenty to twenty-five feet high. At this point the rift, or stratification, runs in northeast and southwest directions and at an angle of from thirty to forty degrees from the face of the cliff. The seams are much contorted, and so far as excavations are made, fall nearly perpendicular into the rock. The masses of ore found in this place were in the seams, and in pockets, and could be seen along the face of the cliff for several rods, and at right angles to the stratification for fifty or sixty feet. The top and side of the out-crop have been cut off or ground down by the drift agency, so that the ore exposed on the face of the cliff showed the size of each pocket or mass. Work was commenced here during the summer of 1871, and the face of the rock for several rods broken off by powder blasts, to from four to six feet from the original front. During the summer of 1872 a shaft has been put down at the north end of the works, which has reached the depth of twenty-five feet, and horizontal adits are being driven from the shaft in two directions, following masses of the ore. From a serpentine out-crop on land belonging to Alfred Miller, half a mile south of the last named location,

a few hundred pounds of ore were taken from the surface, and on the next lot south, on what is known as the Dea. Page place, about fifteen tons were taken from a pocket which appeared at the surface. This last named locality was thought to be the richest, or to contain more of the ore than any others where developments have been made.

The position of the ore in all places where examined was very much the same; it was in irregular masses, or pockets, and nowhere appeared in any concentrated vein or lode. One mass taken from Miller's ledge weighed over twenty-two tons—others from four to seven tons. No attempt has been made to drive into the deposits, except the twenty-five foot shaft at Miller's. The labor expended has been entirely upon the surface, following only such out-crops as would warrant the expenditure of time and powder.

What the result would be by making examination far into the deposits, no one can tell, for the reason that so little mining has been carried on for these ores in this country that we are unable to learn what have been the facts in relation to the position and character of the deposits. These ores have been found to contain over sixty per cent. of chrome, and would be a scource of profit to the owners if they could have the benefit of transporting them by rail.

Swift & Co., of Boston, Mass., are the parties who have made the effort to develop these ores, and they contemplate erecting a crushing mill early next season. They took out and sent to Boston during the summer of 1871 one hundred and forty tons, which came from five locations. The amount mined during the year 1872 has not been ascertained, and at this time, October, they are vigorously at work at two or three points.

Very extensive deposits of specular and magnetic iron ores are deposited in these serpentine ranges. That at

Troy was formerly worked and the wares manufactured from the ores have proved to be of the best quality. Wrought iron was made to some extent; one lot which found its way to Philadelphia was used for boiler plates, and found to be capable of sustaining a greater pressure to the square inch than any iron worked there. Steatite also abounds, some of which is as pure as any found in New England. Asbestos may be seen in the seams of almost every outcrop of the rock. At Lowell, during the summer of 1870 several tons were taken out and sent away, since which time but little has been done towards mining for that mineral.

The serpentine rocks are in many places as free from rifts or shakes as a rock can be, are of a light green color, sometimes mottled with yellow and white spots. It is easily worked and takes a high polish, and would make a very ornamental stone for inside work. This deposit of the serpentine rocks is more extensive than any deposit in the United States, and probably greater than any other deposit on the continent. Should works be established for sawing and working this rock into the various forms and uses for which it is valuable, it would soon take a front rank among our native ornamental stone.

# GRANITE QUARRIES.

A PAPER READ AT THE LATE MEETING OF THE STATE BOARD OF AGRICULTURE, &C., AT MONTPELIER.

BY J. S. SPAULDING, LL. D.

In speaking of the Granite of Washington county, it will not be expected that I should enter upon any discussion in regard to its geological position ; it is enough for our present purpose to ascertain its locality, its quantity and quality, its commercial value, and the ease with which it may be quarried.

The granite of this county, like that of all other localities, is composed of quartz, feldspar and mica, indiscriminately mixed together ; it is coarse or fine, according to the state of its constituent minerals ; it is of every shade of color, but the most esteemed for monumental and building purposes is of a light gray shade.

Granite is one of the lowest rocks with which the geologist is acquainted, and yet it forms the summits of the highest mountains, and is found in veins varying from a few inches in thickness to those that are several yards in width. From its crystalline structure and the position it occupies, there is no doubt that granite has been melted, and it is also certain that many varieties are the results of remelting and reconsolidation of the stratified rocks. In this way only can geologists account for the fact that, while some granites

are found among the oldest rocks, others are more recent in their origin than some of the stratified formations. It is evident that the granite of Washington county is thus formed. By some convulsion, or change in nature, the mica slate formation, in which the granite of this county is found, was rent and the melted matter was forced into and filled the crevices, engulfing at the same time fragments of limestone and mica slate.

In the northern part of this belt of granite these detached fragments are so promiscuously scattered through it, that the granite is nearly useless for building purposes. It is, furthermore, evident from the situation of these blocks of limestone, and fragments of slate, that they must have been associated with the granite while in a state of fusion.

The granite in this county out-crops in Berlin, Barre, Plainfield, Marshfield, Calais and Woodbury. That found in Berlin is of a fine grain, and valuable for building and cemetery purposes; the amount quarried at Berlin is about 2000 cubic feet per annum.

The granite in Plainfield, Marshfield, Calais and Woodbury is not, as I understand, quarried very much, and owing to the seams of quartz and fragments of limestone and slate, it is very little used except for underpinning. Though the granite in these towns is generally of a coarse grain and imperfect in its formation, still, in many places, it is found suited for all architectural purposes.

In Barre, granite forms two elevations estimated at 500 or 600 feet high and containing an area of about 1,000 acres. On both these out-crops the granite lies in tabular sheets, the outer edges of which have been worn by drift agency, so as to form the contour of the hills. In the emergence of the melted granite, the *debris* overlaying the slate was thrown together and formed a barrier between

the two out-croppings; this having been removed by the action of water, a deep valley now separates the two granite hills. The space between them is not far from two miles. These quarries are also situated about two miles from Barre village. The easterly hill, known as Cobble Hill, rises abruptly on the south, while on the other sides the ascent is so gradual that large teams can be driven to its summit. The sides of the southern hill, called Millstone Hill, are of very easy ascent to its top—the form of the hill being hemispherical.

In estimating the quantity of granite in these two localities, we run the risk of being called visionary, but we enter upon it knowing what we may say. It is admitted by all who have visited the granite quarries in Barre, that the quantity is large; but, so far as I know, no one has ever attempted to give an estimation in cubic feet, or reduce its value to dollars and cents. Passing a horizontal plane from the west parallel to the general level of the land surrounding these hills, we shall cut off from these two elevations probably not less than 8,000,000,000 cubic feet of granite. At five mills per cubic foot before it is quarried, we have $40,000,000, or forty times the whole grand list of this state; giving it a value of ten cents per cubic foot after it is quarried, we have the enormous amount of $800,000,000, or eight times the whole taxable property of Vermont. From this statement of the approximate quantity of granite in Washington county, we may infer that it is sufficient to supply any demand for such material either at the south or west for any length of time. The quantity is not only inexhaustible, but in quality surpasses all other varieties; its color is light gray, and free from iron and other ingredients that render many granites useless for building or monumental purposes. President Hitchcock says he has never met, in this

or any other country, with granite of a finer grain and better adapted to architectural purposes than that found in Barre. The minerals of our granite are so finely pulverized and so compact in their combinations that it is capable of receiving a high polish; and when exposed to the action of the atmosphere, it resists so well the "tooth of time" that blocks cut fifty years since, and exposed to all the changes of climate and moisture, are now as perfect as when they left the shop of the artizan one half century ago. The New Hampshire and Quincy granites have a dark and sombre look that gives the buildings and monuments constructed of them a heavy and gloomy appearance. The light gray color of the granite in this county is such, that, when small dwelling houses are built of it, there is a light and sprightly aspect to the whole structure. When this same material is wrought and used for larger buildings, it gives to the edifice the look of such grandeur and stateliness, that a man by a walk of a few rods from this hall can better appreciate than I can describe. For monuments and cemetery work it cannot be equaled for beauty; the fineness of its grain and compactness of its structure give no place for the roots of lichens or mosses that one so frequently sees on the marble slabs in all the cemeteries of Vermont and elsewhere. That the granite of Washington county is admirably fitted for architectural purposes, we can not refer to a better specimen than that of which the State House is built. Few probably have ever seen a better sample of building material than is exhibited in the walls of our own capitol. A test of fifteen years is sufficient to show that Barre granite is free from iron and other minerals that deface the walls of many public and private buildings.

Having spoken of the location, of the quantity and quali-

ty of the granite of Washington County, it remains for me to call attention to its commercial value, and the ease with which it may be quarried. In speaking of its valuc, I am aware that the price of any commodity at the place of its production depends on its quality and the facilities of transportation. The iron and coal of Pennsylvania must reach a market before they are of much value to the owners. The agricultural products of Vermont must be carried to the consumer, or otherwise they decay in the storehouses of the producer. Thirty years ago the land embracing the rich marble quarries of Rutland was sold for an old mare and her colt. The facilities of transportation were increased, and forthwith a value was given to the heretofore worthless article. Quality, without facilities of transportation, will never give any article a mercantile value.

The granite of Washington county, like all the productions of the earth, must be valued in proportion to its usefulness and demand. Its use for architectural purposes, we have seen, is excellent, and in the opinion of President Hitchcock and other geologists, it cannot be surpassed by any rock of its kind, in this or any other country.

Should the demand be extended and the facilities for conveying this granite to market be increased, I see not why this county has not a source of productive labor even greater than that of any other in Vermont. Notwithstanding the difficulty and expense of conveying it to a railroad station, the demand for Barre granite is increasing every year; not for from 1,000 tons, or 12,000 cubic feet, have bcen quarried the past season. A large part of this has been sent to western Vermont and northern New York. Orders for it, I understand, have been recently received from Ohio and Illinois. Let the same amount of money be expended and the same energy put forth for developing the granite of

Washington county, as there have been in the marble enterprise of Rutland county, and no one would doubt the success of the undertaking. To quarry marble, to dig gold, to mine coal, copper or iron, and raise them to the surface of the earth, oftentimes requires an immense outlay of funds for mere preparatory work; and frequently all the efforts of the projectors of these enterprises prove abortive. To quarry the granite of Washington county there is no risk in the undertaking; the material sought is seen; enough lies above the general level of the surrounding country to supply, for hundreds of years, any reasonable demand.

On the two hills in Barre the granite is found in nearly horizontal strata, varying in thickness from two inches to ten feet. From this some geologists suppose it to be gneiss, which rock is composed of the same minerals, and differs only from granite by having a distinctly stratified or slaty structure. "There are cases," says President Hitchcock, "where it is very difficult to decide whether the rock be stratified or not; even those rocks which all geologists concede to be granite, such as those at Barre, when worked evince such a disposition to split in a certain direction that the workmen generally regard them as stratified rocks; the strata correspond with the 'rift' or cleavage planes, and intelligent quarrymen, working upon granite, are as careful to determine the direction of the 'rift' as those engaged in quarrying slate."

Granite can readily be split at right angles with that of the rift or cleavage, but not in a diagonal direction. For pillars designed to sustain great weight, the utmost care should be taken to have the length correspond with the cleavage or rift. Taking advantage of this characteristic, the quarrymen run their lines on the rift from ten to two hundred feet in length; and with the aid of half rounds

and wedges, the blocks are separated from the tables or sheets. It often happens, when blocks of large dimensions are wanted, that a new face or edge of a sheet must be laid open; to remove the edges of the overlying sheets, and expose a layer of suitable thickness, powder is used to throw off the upper strata. To a man who has never seen granite quarried, it seems a mystery how blocks seventy-five or a hundred feet long, six feet wide, and from four to six feet thick, can be cut almost as straight as if sawed from a bed of solid rock. One block, quarried last season on Cobble Hill, seventy-five feet long, contained no less than 1,500 cubic feet, and weighed not far from 125 tons.

Granite, like all other productions of nature, requires the incorporation of human industry to give it an exchangeable value. The water of the Merrimack, for thousands of years, flowed over the rapids opposite the cities of Lowell, Manchester and Lawrence, and no one sixty years ago considered it of any practical account; but directed by intelligence and human skill, it is the source of great wealth, and its loss would be felt not only at home but throughout the world.

The timber of our forests in the place of its growth has a small commercial value, but as soon as it is combined with the labor of the lumbermen, it becomes an element of the utmost importance to the prosperity of the State.

The inherent energy and the hidden activity of the soil, left uncontrolled by human industry and intelligence, would never spring up into the golden corn, or clothe our fields with the rich harvests of grain.

The thousand streams of Vermont will always, as they ever have, continue to leap from rock to rock in their channels, until the men of energy and means shall direct their power to effect such changes in the raw materials of our State as shall confer upon these substances an intrinsic value

that will not only enrich the producer, but in the change leave a large margin for the manufacturer.

In like manner the granite of Washington county, to become valuable to its owners and a source of wealth to the county, needs for its development the hand of human industry and skill to give it form and direct its movements.

Prof. Seely of Middlebury expressed great satisfaction in listening to the paper, and highly appreciated its value as giving an idea of the untold resources of Vermont. Such papers as the one we have just listened to show the vast natural resources of our State. Too often we hear the remark, "Vermont isn't much," and it is this feeling that tends to lead so many to emigrate. In truth Vermout is one of the best states in the Union. We think too little of our State, he observed, and our young men go West, leaving one of the best states in the Union. There is abundance of room and material for the profitable employment of capital and brains here. In reference to building materials, he regarded granite as superior to marble, as our climate is pretty hard on the latter material, and it will gradually go into decomposition. The marble monuments in our cemeteries soon show decay, and if we would have lasting ones we must make them of granite.

In response to an inquiry by Mr. Heath, Dr. Spaulding replied that there was good granite in the town of Woodbury, but he had understood it was difficult finding blocks of much size free from quartz.

Hon. John Gregory spoke of the superior quality of the Barre granite, and stated that whilst in Albany last fall, he examined the foundation of the new capitol building being erected there, of Maine granite. The superintendent informed him that they were troubled to get blocks in Maine

of the size required, and that they had been examining a quarry about three miles from Keene, New Hampshire, the citizens proposing to build a railroad that distance to take the granite blocks to the main line of the road. The superintendent expressed a decided preference for the Barre granite, and said it would have been used for the building could it have been reached by railroad.

Mr. Wheelock, of Barre, was much interested in the subject, and deemed the quarries of that town of great value to agriculture, as, when worked to the extent they would be some time, they would create a larger home market for the productions of the soil. Removing the granite did not impoverish and injure the soil like taking off the forests.

Dr. Hoskins said the information in Dr. Spaulding's paper was interesting, and to a great extent new to him. It was bad policy, in a State so rich in resources as Vermont, to suppress the fact and say nothing about it. We were too much like the old lady, who being compelled to go to market with vegetables from her garden. as a means of livelihood, had a severe struggle to overcome her pride, and on account of this commercial weakness, met with but poor success. She secreted herself behind a pile of lumber, and then waited for customers, who of course did not come. When aroused to more activity by a sympathizing friend, she cried, in a faint voice, "Fresh greens," but added in the next breath, "I hope to the Lord nobody heard me."

Mr. Heath had made an examination of the granite belt in this county, extending into the northwesterly portion of Orange and the southeasterly portion of Caledonia counties. It did not crop out much in Plainfield, a little too much in Marshfield for farming purposes, and still more in Woodbury. Some was to be found in the southwest part of

Peacham, and in the gores, and some on the Tucker farm, in Calais. He believed the best qualities were to be found in Barre and Woodbury, where it existed in untold quantities, and would soon become marketable from the proximity of now constructing and projected railroads.

# RUTLAND COUNTY MARBLE,

## WITH A HISTORY OF THE MARBLE INDUSTRY OF VERMONT, AND A STATEMENT OF COMPARATIVE VALUE.

AN ADDRESS DELIVERED BEFORE THE STATE BOARD OF AGRICULTURE, &C., AT BURLINGTON, JAN. 24, 1872,

BY J. E. MANLEY, ESQ., OF WEST RUTLAND.

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In the creative wisdom of God, displayed alike in the creation of earth and man, we are to suppose that the earth from the first had been preparing for the service of man. For him the "darkness" and "waste" which had rested upon the earth through periods of rest and activity, had been restored to order and beauty, forming part of a system of means, pointing to the success and prosperity of man, the subordinate end. From time to time organic fires had crystallized the granite and piled it into lofty table lands, and the never wearied waters had washed it down to extensive plains of vegetable soil. The earth, vibrating with electrical shocks, has become veined with metallic ores. In the ages of comparative quiet through which the earth passed, long accumulating vegetation of preceding periods was for man transmuted into stores of fuel. The ferruginous deposits of primeval waters were becoming iron, and for man successive races of destroyed animals were changed to

useful limestone; the interior of the earth becoming a storehouse, containing everything for the service of man, so that when the time should come for him to open and gaze upon her treasure, "the blessings of the deep which lieth under," he might gratefully recognize the benevolent foresight and wisdom of Him who had placed them there.

Perhaps this wisdom is not more displayed in any of the deposits than is manifest in the deposit of limestone, usually termed marble, embracing a system not manifest in anything else which God has made. The deposits of marble in Rutland county and in the State present a different appearance and texture in almost every opening not upon the same strata. The quarries at West Rutland, the most celebrated in the United States, are mostly upon the same deposit—dip to the east at the surface at an angle of about 45 deg.; although in some of the openings the strata is more erect, and in others less than 45 deg. There are openings of recent date upon the west of those most celebrated; and the longest worked, and located at the base of the West Mountain, dip also to the east at an angle varying from 38 to 45 degrees. These openings, one of which dates back as one of the first in Rutland county, are not as compact, and are upon the same strata more changeable in texture and color, than the older worked and more extensive quarries of which I shall directly speak. One of these at the base of the West Mountain contains serpentine and verd-antique marble, the texture of which is very uneven, and when exposed to the sun and rain becomes more brittle and hard than any other marble known to the trade. The composition of verd-antique marble not being the same as other marbles accounts, perhaps, for the unusual condition from exposure. This marble is not now quarried, and I have

been thus particular in its description, as there is no other marble quarried in Rutland county resembling it except the brocatelle, known to the trade as "brocadilla." The deposit known as the quarry of the Green Mountain Marble Company is developed about 50 feet in width, and consists of eleven layers, varying from 2½ to 5 feet in width. The No. 1 and average marble in this quarry composes about one half of the opening, and has proved to be very desirable marble, and sound at a depth of 25 feet from the surface. The marble upon the surface of this quarry was simply decomposed limestone, and all the layer was very soft when the quarry was first opened,—illustrating a principle that to be sure of a sound quarry, soft and decomposed marble is generally found upon the surface, and also where the marble is fine and hard upon the surface, usually great depths are attained before sound marble is reached.

These recently opened, as above stated, embrace a large proportion of the white marble, and some of the layers are very fine, and much sought by dealers for carving purposes. The older and more extensively worked and most valuable quarries embrace a width of 110 feet, consisting of 24 layers of marble at present quarried, sawed and placed upon the market, varying in color and texture, and each layer representing a different value. In describing these different layers I desire to be particular in the description of a few, as showing peculiar and unaccountable phenomena in nature.

### SHELDONS & SLASON'S QUARRY.

In the east deposit of Sheldons & Slason's quarries, which I am now describing, we find essentially the same principle and phenomena exhibited in all the different quarries of this rich deposit.

The east or top layer in this quarry is now quarried to a depth of 185 feet, and dips 45 degrees at the surface and 50 degrees at the lowest depth attained; is four feet thick, 2½ statuary marble and 1½ of lime rock. In this opening, east of the general line of quarries, are embraced eight different layers, forming 31 feet of the 110 total width of known marble on this range. Two of these layers are of average and No. 2 marble, both of which form about one-fourth of the marble. While only a fifteenth part is of statuary marble, all the other layers are of No. 3, veined, blue and mottled marble. With this and other blue layers is often found white marble, distinct in color and texture. The 7th layer in this opening presents a strange phenomenon in nature, being for some distance from the surface white, and at a distance of 75 feet from the surface changing to a deep blue. This layer is nine feet thick. The 8th or west layer is mottled blue, known as Dore blue, free from flint, and susceptible of a very fine polish. The No. 3 marbles embrace all the cheap marbles, and in the absence of better stone will not pay the expense of manufacturing.

The west deposit embraces 79 feet of the general deposit, and contains sixteen layers of marble, and represents nearly all the quarries in successful operation at West Rutland. Dip of strata at surface 50 degrees; at a depth of 100 feet stand at an angle of 85 degrees. The lower or east layer is of average and No. 2 marble, is 2½ feet thick at the surface, and at a depth of forty feet is 7 feet thick. Layer No. 2 is of statuary marble, of excellent quality and six feet thick. Statuary marble bears the highest price of any in the market, usually selling for $12 per cubic foot. The proportion found is far too small for the demand, forming, as it does, only a small proportion of the general deposit. 3d layer, average and No. 2, 4th and 5th,

and No. 3. The 5th layer is 4 feet thick, has in the center good No. 1 and statuary about one foot thick, and here again geological science must explain the fact that where No. 1 and statuary marble are found in the center of a layer, invariably exceedingly poor, flinty and worthless marble is found upon either side.

The 6th layer is of brocadilla marble, green and white varied, the white predominating. Is a very durable marble for building or ornamental work, but owing to the presence of flinty particles it will not receive a high polish. Layer 7th from the east consists of average No. 2 and No. 3 marble, four feet thick. Layer 8th is of No. 2 and average, ten feet thick, white upon one side and variegated or No. 2 upon the other, and blending so imperceptibly with the white that no dividing line is traceable. This layer at the surface was six feet thick, and increasing in thickness downward; and this is the case with all the layers in this quarry. No. 9, 10, 11 and 12 are all of No. 3 marble, of different colors and texture. No. 13, average marble, a grade between No. 1 and No. 2, or white marble denoted by the presence of color, generally of a blue cast, sometimes quite dark, and again of a greenish hue. Very little color of any grade is adduced in this grade.

No. 14 is a layer, 3d from the west of developed layers, embracing lime rock and marble, 5 feet thick. This layer at the surface was marble, very soft, and at a depth of 80 feet from the surface is changed to lime-stone and flint. The most curious freak of nature is here exhibited that has ever been known in the history of marble quarrying, peculiarly illustrating the principle exhibited by some people in minding other people's business. This layer, not content in changing from marble to flint, runs through the layer east of it, cutting it completely off by an off shoot from two to

six inches thick. Without design, doubtless, representing the influence of people who began well in life, but without moral courage to hold out, not only defeating the original design of their creation, but thwarting the purpose of honest people. No. 15, is a layer of No. 2 and 3 marble 2½ feet thick. No. 16 and west layer is nearly developed and closely resembles the Italian marble in texture and color, and is therefore called the Italian layer, a water colored and variegated marble. Thus we see that from this statement nearly one-half, 35-79, of the most valuable deposits is of No. 3 or unpaying marble, whilst 44-79 is of largely paying quality, consisting of statuary, No. 1, average, and No. 2. Many people in search of the great wealth found in rich deposits of marble, often lose sight of the fact in their explorations, that unless a quarry has a certain proportion of the paying grades of marble, it will not pay to work them, although sound marble may be found upon the surface of the ground.

### SUTHERLAND FALLS QUARRY.

The next deposit, most celebrated and second in value, is at Sutherland Falls, near the line of Pittsford. It is much harder than the Rutland marble, heretofore described. This marble is sought by dealers for monumental work, being very durable and susceptible of a very fine finish. It is all variegated, and some of it presents a brecciated appearance rather than stratified rock. The No. 1 of this quarry resembles somewhat the veined marble of Italy, used in this country, but unlike it in texture, from the presence of small particles of flint as in the brocatelle, will not receive as even or as high polish as the Italian, but, nevertheless, receives, under skillful hands, a very fine finish. The other layers most desirable and most valuable are the dark and light

mourning veins, resembling very much the marble found in the Pyrences and in some parts of France.

The dark mourning vein has a ground of deep blue, whilst the characteristic color is nearly black, running through the layer continuously but zig-zag in its course, presenting a very beautiful appearance. The light mourning vein has the same characteristics, but the ground being nearly white instead of blue. Both of these layers are free from flaws in their general character and receive a very fine finish. A few rods to the east of this quarry is a deposit of white marble of considerable extent, but no sound marble has ever been obtained, so that it is without name in the list of quarries. The deposit in line with the Sutherland Falls quarry is different in color and texture as you go north, also south. About one hundred and fifty rods south is the quarry of the Columbian Marble Company, being one of the oldest opening upon this deposit; contains variegated and almost black marble.

This marble, for the second time, has been but recently put upon the market; but is attaining an enviable reputation for mantel and monumental work, being quite hard and fine, and stands at the head of dark marbles. There are several deposits at Pittsford, Brandon, and Danby, a minute description of which I am unable to give, except to say that the marbles for most of these openings have been successfully placed upon the market. The marble of Danby is much coarser than the same quality of the Rutland marble, and the No. 1 being coarser is of less value than the Rutland No. 1, yet quite as durable when exposed.

## EUREKA MARBLE QUARRY.

But I should do injustice did I not mention the opening at Federal Bridge, upon the east bank of Otter Creek, mid-

way between Sutherland Falls and Rutland. The marble from this opening resembles very closely the Italian, and also the No. 1 of the Sutherland Falls marble, is fine and of a variegated appearance. The owners of this new and apparently valuable opening have recently built a new mill, and everything promises success.

### THE MARBLE BUSINESS.

The first opening for marble was made in West Rutland in 1838, and promised success for a while, but its importance was eclipsed when in 1843 William F. Barnes, the pioneer in the marble business, commenced work upon the rich deposit of what now belongs to the Rutland Marble Company. The Sutherland Falls quarry was opened about the year 1830, and has been worked at intervals ever since until to-day. Although it boasts of no white marble, it ranks in importance second to none in Rutland county. This is owing to the fact that colored marbles are more durable and more sought by purchasers for monumental purposes than the white marble, so much used in its early history. But the use of No. 1 and statuary marbles has demonstrated the fact that their composition is unsuited for external uses; the experience of years proving more to the practical mind than science could possibly accomplish.

There are twenty marble mills in Rutland county, in which are 200 gangs of saws, each gang having about 22 saws. About 50 gangs in different mills are at present idle from various causes, the most apparent one being the want of capital. Some of these gangs are idle for want of paying marble to saw, the deposit upon which they are located being worthless as a practical enterprise. These saws, in the most approved mills, will pass through a block of marble, free from flint, 4x6 feet, at the rate of one inch and a

half to the hour, each gang sawing 220 feet in twelve hours, and the 150 gangs now in operation sawing 33,000 feet of marble every twelve hours, making an aggregate annual production of sawed marble in Rutland county of 9,900,000 feet. It is estimated by statistics and careful observation that of this marble there are $1,500,000 worth sold in the markets each year.

It will be difficult to give anything more than a comparative value of the different marbles quarried in Rutland, being, as an article of merchandise, subject to advance and decline. But there is an intrinsic and standard value attached to marble of some grades which the fluctuations of markets cannot affect, or the niggard necessity of a ten per cent. loan destroy. Like the gold dug from the mountain side, it has a standard value, and when the capitalist can secure a deposit largely composed of statuary No. 1 and average marbles, he can invest with perfect safety, and success will certainly crown and repay confidence so bestowed. But that quarry which is composed of three quarters No. 3 marble, a thin layer of statuary, and a little No. 1, is dangerous to both the pockets and morals of any man who is bold enough to engage therewith. It will prove a pecuniary mill-stone carrying him to the very depths of bankruptcy.

In the early history of marble quarrying the process was to blast from the bed with small charges of powder, but the folly of this was soon ascertained, and a better and the present way of quarrying was discovered. The early process destroyed a great deal of marble, and after a great expense in opening a quarry, it was natural that a better way should be sought out. The present mode, you are aware, is to cut channels with drills sharpened for the purpose, about two inches in width, and at any desired length or angle. The marble is raised from the beds with "half-

winds" and wedges placed in holes drilled for the purpose. It is considered a day's work to cut one and a half feet of such a channel, although experienced men can cut double that amount.

The cost of quarrying marble, of course, depends much upon the texture of it; but in most deposits can be quarried at an expense of seventy-five cents per cubic foot. It is usually more expensive to quarry the poorer grades, as more flint and foreign substances enter into their composition. Contracts for quarrying have been made as low as fifty cents per cubic foot, but this is regarded as below the actual expense of quarrying. With an expense of seventy-five cents for quarrying, and the same amount for sawing, and an additional expense for selling, we have an aggregate cost of $1.75 for the manufacturing of marble and placing it in market. There is at least one-half of the marble quarried that is sold for a less sum than $1.75; much of it is sold for $1.00 per cubic foot.

Therefore the theory that poor grades of marble will not pay for manufacturing, and *are impolitic* to open, much more to work such quarries. This theory also shows the net profit of quarrying good marble—a large per cent. being the net proceeds thereof. It has long been a subject of contemplation why sound marble is more readily found in Rutland county than in Addison and Chittenden counties. The theory advanced by some is that in the "drift period," the debris and loose rock were washed from the higher places and mountain sides of Rutland to the lower counties of Addison and Chittenden; certain it is that no successful openings have been found north of Brandon. This theory, if correct, will also account for the solid marble of Danby and Dorset. The theory may yet be demonstrated that when

a great depth, perhaps fifty or seventy-five feet, has been reached, sound marble may be obtained in these counties, but I divine the reason not to have existed upon the surface, but within the earth. It will be noticed that the marble in Middlebury, Shelburne and Hinesburgh are all of a similar cast—the white marble being very fine in texture, but rarely sound—when the colored marbles in the same deposits are generally sound.

These reasons, with the other peculiarities and phenomena, are sufficient to guarantee the fact that marble was placed in its present position by the result of plutonic action, although some of the layers in their composition and position would warrant and suggest aqueous deposits. But this last theory could not in any way account for the present condition of the highly crystallized marbles, like the statuary and No. 1 marbles.

Stubborn facts, as revealed in the history of the marble business of Vermont, are sufficient to warrant just conclusions, without resorting to theories not fully based upon practical knowledge.*

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*It has been the object of this paper to give the extent of deposits enumerated, and not different quarries, but I have mentioned some quarries as representing different features of the same deposit, nor is time and means at hand to give in detail a description of all the quarries in Rutland county. I mention the quarry of Sheldons & Slason as they have developed the greatest number of layers of any firm in West Rutland, and a description of their "new opening" describes all the openings upon this deposit, consisting of the quarries of Parker, Gilson & Denny, Rutland Marble Company, Sherman, Adams & Williams, and the Manhattan Marble Co. I mentioned the Sutherland Falls marble quarry as representing a new deposit of marble of a different nature and color, also the Columbian Marble Co., and the Eureka Marble Co., as quarries upon this deposit but varying in color.

# THE MARBLE INDUSTRY OF SWANTON.

A PAPER READ AT THE MEETING OF THE BOARD OF AGRICULTURE, &C., IN ST. ALBANS, MARCH 6TH AND 7TH, 1872,

BY GEORGE BARNEY, ESQ., SWANTON.

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As yet no white marble to any extent has been discovered in northern Vermont, at least none north of Burlington. All are colored. The first to be mentioned is the "Dove," it being of a dove color, which gave it the name. Ledges of this marble crop out at intervals all the way from St. Albans Bay into Canada, almost on a line due north and south. How much farther north or south this formation may be traced, has not come to the knowledge of the writer, but he is of the opinion that the ledge worked for lime, between Winooski and Essex Junction, is of this same formation. It makes excellent lime, and is worked for that purpose by C. W. Rich, of Swanton, also on what is known as the Gadcomb farm, in Swanton, and also near Highgate Springs. There is a quarry, or rather a number of quarries, of this kind of marble about half a mile south of the village of Swanton Falls, on the ledge known as the White Rocks. These openings were made at a very early day, and the blocks taken therefrom sawed into grave-stones, mostly, and may be seen in almost all the grave-yards in northwestern Vermont. The texture is very fine, susceptible also of a high polish, and withal very durable.

These quarries have not been worked for many years, the chief cause of which has been that it is not as easily quarried and manufactured as other marbles. There is a rift in its make, so that it breaks or splits one way much easier than the other—a trifle like slate, though much more compact and solid. This prevents blocks being taken out in very good shape for handling or sawing to advantage, when quarried in the old way with powder, as they were when the quarry was worked. The recent improved method of quarrying by channeling could be used with good effect on these quarries, and blocks taken out sound and in good shape.

Further remarks upon this topic will be reserved until we come to speak of manufacturing.

The next quarry we shall speak of is of Black Marble in Canada, a few rods north of the Canada line, and is some fifty rods west of the Vermont and Canada R. R. track, where it crosses the line, on a ledge considerably above the railroad. I speak of this next in order as it was the next quarry after the Dove that was worked in this section. This marble is of fine texture, and takes a high polish; was rather expensive to quarry, and blocks were not of the best shape, but the chief objection was that it contained pyrites, a substance which when the marble was polished looked like specks of brass scattered over its surface. There has been, however, a large quantity of this marble sent to market.

The next marble quarry worked and brought into notice was what is known as the Clark Quarry, on the east shore of Isle La Motte. This, also, was black, much like the Canada marble in texture, produced better shaped and sounder blocks and was more easily quarried and free from the brass like specks of the Canada marble. This is known among marble workers as the Isle La Motte polishing marble. It being on the shore of the lake made it accessible by boats,

all which advantages were against the further working of the Canada quarry, and work there was suspended, probably never to be resumed. It was the fortune of those that opened this Clark quarry to strike a layer of marble at the first, about two feet thick, of a very superior kind, regarded fully equal to the Irish black marble in every respect, but this layer or sheet was only a few feet above the surface of the lake in high water, and withal dipped downward as it was quarried from, and as the bank rose rapidly the marble above accumulated, and this marble above was of an inferior quality, having many white specks and curls. This fine layer always bore a high price in market.

There was a quarry known as the Hill Quarry adjoining the Clark quarry, but the marble taken from it, though black, never had a first rate reputation, the marble taken from it lying all above the fine layer heretofore spoken of.

We next come to speak of what is known as the Fisk quarry, on west shore of Isle La Motte. This quarry is extensively known. The marble taken from it is of about the same texture as that of the Clark quarry, hardly as fine, and is not susceptible of as high polish. It is of marine formation, in uniform beds or layers of different thicknesses, from six inches to four feet; these beds gradually ascend from the lake shore eastwardly, giving a gradual and even descent from all parts of the quarry to the lake. There is a very light soil overlying the marble, and sound blocks are quarried from the very surface, so that there is no waste to remove to get at good blocks. This quarry is very extensive, having a tract already worked nearly a quarter of a mile in length and about fifteen feet deep, of what is known as black marble. Below this is a layer of grey, or as has been recently named, mourning granite. Not that it is really granite, but has the appearance of granite both in

color and texture. This layer at the shore is some eight feet thick, and as it recedes from the lake southeasterly, diminishes in thickness until it runs entirely out at a distance of some fifty rods, but in a northeasterly direction seems to hold its own, which goes to show that while this grey, wedge-shape layer was forming from ocean deposits, the sea bottom was gradually rising, or had already been raised at the south, which also is confirmed by all the layers of marble having a dip northward. This formation gives good evidence from its appearance of having been formed in good part of minute sea shells or perhaps encrinite. Below this is the same black marble of that above, two sheets of about two feet each in thickness, when we come to a layer of shale some six inches thick.

This constitutes the present floor of the quarry, no marble of consequence having been taken out below this. Where these lower layers crop out, however, on the southwest, they show a greyish color, in regular layers, and as these layers are followed down, one below another, for perhaps twenty feet, we come to a layer near the lake of a marble called encrinite, being composed apparently of small shell-like particles, of nearly all colors, a dull red predominating. It takes a fine polish, and by many is regarded very beautiful as well as curious. There have been but few blocks taken from it that have been sawed, in consequence of the thinness of the layer—about eight inches—and its nearness to the lake making it difficult to get, except in low water. There is a layer of considerable thickness of this kind of marble, the colors not as brilliant, however, on the opposite side of the lake, in the town of Chazy, and a number of blocks were taken from it to New York some twenty years ago, but for some cause it proved a bad speculation and has not been worked since. The stone for the

piers of the famous Victoria bridge were taken from the Fisk quarry.

There is a quarry about half a mile south of the Fisk quarry, on the farm of Judge Fleury, from which a large quantity of stone has been taken in past years, mostly for Fort Montgomery, about twelve miles north of the quarry, near Canada line. This quarry affords good blocks for heavy purposes, such as forts, bridges, canal locks, &c., but is unsuited for sawing, as it is coarse in texture. The peculiarity of this quarry is that its formation consists almost entirely of minute shells, large enough, however, to be clearly perceptible to the naked eye.

The depth of the breast of this quarry is about twelve feet, the whole depth in one solid layer and uniformly of the same material, and there is good reason to suppose this formation extends the whole width of the Island at this place, perhaps one and one-half miles. Its dip is northwardly, and if the layers continue at the same dip as at the quarry, it would carry it some forty feet probably below the Fisk quarry formation. Between this and the Fisk quarry, about equidistant, Judge Fleury has opened another quarry recently, and taken out some stone for bridges and canal in Canada. This is of dull bluish appearance, of finer texture than the quarry south, and has not yet been tested for sawing purposes. There have been in past years several other openings on this island from which stone have been taken, but they all bear a general resemblance to one or the other of those already described, and we deem it unnecessary to notice them further, as there are none worked at present except the Fisk and Fleury quarries.

We now turn our attention to what is known as the Winooski marble, this being the name given by Mr. Hagar, our State geologist, to a red variegated formation extending

from the south of Burlington to Canada. But two or three places as yet have been found in this deposit that have warranted any considerable outlay in working or preparing for market. One is at Mallet's Bay, north of Burlington. About the year 1854 a Mr. Reed made an opening at this place, and sent a block of 8 or 10 cubic feet to Swanton, to the mills of the writer, to be sawed and tested. The block was sawed and proved very hard, requiring about three times the length of time to saw it that it would any other marble that has ever been sawed in the place. Specimens were taken from the slabs of this block to the cities, and this led to sending some blocks to the cities, but it is believed the enterprise was not a paying one. Not having visited the locality, the writer cannot speak definitely with regard to it, but it is inferred that blocks can be quarried there of good size and fair quality. It is believed that none of this marble has been sawn into slabs in this section, except what was sawed at Swanton some years ago, and whatever has been sent to market has been in the block.

The next of this kind of marble to be mentioned is that taken from the Bullard ledge, on the road from St. Albans to Swanton, near the watering-trough. People had passed and repassed this ledge for years, and no one had looked upon it as of any value, except for the loose stone it afforded for underpinning fences and the like. The manner of its discovery as a marble was as follows: the writer, when returning to his home in Swanton from St. Albans, in the spring of 1859, stopped at the watering-trough near the ledge to give his horse a drink, and while the horse was drinking he observed fragments of stone near by, that had been made in getting stone for the culvert of the railroad. These fragments, and the face of the rock that had been broken, had such a peculiar appearance that he threw a fragment into

his buggy and had it placed upon the rubbing bed, which disclosed to him the fact that there was marble in that ledge of superior quality. He at once got permission from the owner of the ledge to take blocks from it, and drew one to his mill and sawed it and soon after sent it with other marble by boat to New York, and it was sold to the firm of Fisher & Bird, marble dealers, in August 1859. They considered it very fine and thought it equal to the best of foreign colored marbles, and encouraged the writer to go on and extend the business. This is the first of this kind ever sent from this county to market. The marble from this ledge, though considered at that time and for some years superior to any other fancy marble, has been superseded by another variety of the same kind, discovered by the writer and the first block taken from it by him, in the month of January 1870. It is located about one-half mile west of the one last mentioned, and some forty rods south of the R. R. Junction.

This ledge is some fifty feet in perpendicular height facing westward, and seems to have been lifted from the valley below, the strata having an eastward dip of some thirty degrees, and to appearance its geological position must be some distance below the opening at the water-trough before mentioned.

From this quarry there have been considerable quantities sawed and sent to market during the past two years. It is superior to any of this kind heretofore furnished by us, and in fact, is believed, by competent judges, to surpass anything in the line of fancy marbles in the United States. Its texture is fine and hard, the ground color of light chocolate, beautifully blended with still lighter colors, and these all intermingled with clear white spots and veins, giving it,

when polished, a very lively and beautiful appearance. Thus far there has been some difficulty to get blocks from this opening as large as is desirable, on account of the cuts in the ledge crossing diagonally; aside from those cuts the marble is very solid and sound. As yet the depth of breast is only about six feet, but the ledge shows a depth of some thirty feet, all of this kind of marble, but showing more white in its formation than where it has been worked. To this particular variety we have given the name of red-white vein, that it might be distinguished from other varieties.

There are many varieties of the marble now generally known as the Winooski, yet it has some qualities common to all. 1st, it is very hard; 2d, of fine texture; 3d, has a reddish and variegated appearance; 4th, the lighter portions seem to have been broken and but little disturbed afterward, as the breaks all seem to be sharp and angular. The variety consists in the different colors and figures; some is of a fine reddish mottled appearance, with scarcely any white, others are of a dove-reddish brown, light and dark blended—this is the kind that the tables in St. Albans depot are made from; others have the lighter colors predominating, and so on in almost endless variety. The Winooski marble on the Howard farm, about one mile west of St. Albans village, should have been mentioned. Large quantities of this kind of stone are brought to the village, and used for underpinning, base courses, caps, and sills, and the inferior kinds for cellar walls. There have been a few blocks taken from this ledge and sent to Boston, and the railroad company obtained two very large blocks from there, which the writer sawed for them at Swanton, and a part of the slabs, from these blocks, were used for the marble tables at the depot. The colors in these are not as bright and lively as in some other varie-

ties of this marble, yet these tables are regarded generally as very fine. The parties having the right of sawing marble from this ledge have not as yet felt themselves warranted in quarrying there to anv considerable extent, as other kinds thus far have taken the precedence in market.

The first mills at Swanton were wholly employed in the manufacture of grave-stones from the dove marble, and this was quite extensively carried on from about the time of the war of 1812 until it gave place to the Rutland marble, about 1844. It was made, however, in diminished quantities from year to year until about the year 1850, when it was abandoned entirely, and not a block has since been taken from the quarry for sawing purposes. The reason for this was two-fold: First, the dove marble could not be manufactured into grave-stones as cheap as the Rutland—it not being as easily carved, the marble workers gave their preference to the Rutland marble; another reason is to be found in the fact that for years white marble was all the rage. For a few years past, however, there has been a growing feeling among the people, that clear white marble is not exactly the thing for work that is exposed to the weather, however much it may be valued for inside work, and the prevailing taste now is for the more or less colored marbles for monuments, grave-stones and the like; and for the few past years what is known as Mourning Granite, taken from the Fisk quarry, has taken the lead for monumental purposes in this section.

Swanton is the only place north of Middlebury where there have been marble mills, or if so it has never come to the knowledge of the writer, except one or two small mills that were run for two or three years in Highgate, on the Canada marble.

And we now proceed to mention some of the men that

have been engaged in the business, which will lead us to say something of the kinds of marble manufactured as well as the markets.

To Joseph Atkinson belongs the distinction of being the first to erect mills, and engage in the business of marble sawing in this section of country. He erected a mill at Swanton falls in 1812.

The next mill was built by John Ferris of New York, in 1815. Both these mills made little else but grave-stones, and these uniformly two inches thick and of good length, so as to be set in the ground. Stones set in bases were not known in those days.

We forbear to dwell upon the history of the business from this time forward for fifteen or twenty years. Suffice it to say, mills were erected and marbles from Canada and the Isle La Motte were sawed in large quantities and sent to New York market. The Glens Falls block marble being discovered during this time took the precedence in the market and had a tendency to diminish the black polishing marble business here. From 1830 to 1835 the black marble business may be said to have been in its most flourishing condition. There were then constantly in operation six mills, having in all some twenty-five gangs, which were constantly running, mostly on black marble and hearth stuff, sawing, however, dove marble grave-stone to supply the demand.

The year 1837 was a disastrous one to the parties then engaged in the marble business at Swanton. It is believed that every one failed, and from this time very little of the black quarry marble was taken to market.

Some of the mills were suffered to go to decay, while others were appropriated to other kinds of business. Three only were kept running, one of these most of the time on grave-stones and the others on hearths. From this time the

hearth business increased. They were used in the cities for the *hearth* of *black* Glens Falls marble mantles, and as there was comparatively very little of foreign marble imported, nearly all the mantles were of black marble and required black hearths, and these were supplied from Swanton, it not being considered profitable to make them at Glens Falls.

In the year 1840 the writer commenced the marble business by erecting and setting in operation a mill with six gangs. He confined his business at first exclusively to the manufacture of hearths sawed from blocks mostly from the Fisk quarry. At that time there were three men besides himself, engaged in the business, viz: F. V. Goodrich, I. A. Vanduzee, and H. B. Farrar. We often went to market together and generally worked in harmony in selling marble.

The custom then was and had been previously, to saw out a boat load of hearths (some ten to fifteen hundred dollars worth) and send them to New York, and then go down and sell them from the dock, which generally took from two to four weeks, depending upon the state of the market and the amount to be sold.

In 1845 F. V. Goodrich sold his mill and interest in the marble business to E. S. Meigs, and he in turn sold the same to the writer in 1847. I. A. Vanduzee sold his mill and business to the writer in 1850, thus putting him in possession of all the marble business at Swanton except the interest of H. B. Farrar, who confined himself to the hearth business.

In 1852 two other mills were started running on hearths, one by Daniel Platt, and the other by H. & H. M. Stone. The hearth business had already diminished to a large extent, and the increased amount thrown upon the market in consequence of starting two new mills completely broke it

down. One of those mills, after running about one year, discontinued the business, and the mill was converted to other uses. The other run occasionally about a year longer, when that was shut down. Mr. Farrar continued to do something until the year 1864, when the writer bought from him the stock he had on hand, since which time one of his mills has gone to decay, and the other is converted to another use.

The question very naturally suggests itself, why has the demand for black marble so diminished? I will answer briefly. Up to about the year 1848 nearly all, say nine out of ten, of the mantles made in New York were of black marble. The Glens Falls company had a monopoly of the market, and so far took advantage of it as to make it oppressive to the dealers; at least they (the dealers) thought so. This contributed largely to make marble manufacturers discontented, and they encouraged the importation of the Italian marble, and mantles began to be made from it, from the cheapest to the most costly kind. The marble workers very naturally recommended it to their customers as being all the fashion, a fashion, of course, which they themselves had created, and from this time white and the lighter colored marbles became all the rage. The demand for Glens Falls marble nearly ceased, hardly any mantles being made from it, probably not one in a hundred, so that by the year 1854 nearly all demand for black marble for mantles ceased, and of course if no black mantles were made no black hearths were wanted, and this has remained so till the present day. Yet there have always been some black hearths used, in one way or another, but the demand is limited compared to what it was.

It will be perceived that from the year 1864 to the present time, whatever of pleasure or profit there has been in

the marble business at Swanton, the writer has had the full enjoyment of, and for the good reason that no one, looking at the record of the past in this line, has felt it safe to invest in the business. Yet the writer, by keeping a pretty close watch of what the market required, and supplying that demand, has been able to "still live," and has some hope, if life is prolonged, to bring the business back to its palmy days. One reason of his being able to contiuue the business was that when the demand for hearths diminished, he has endeavored to make the tile business take its place, and he will here narrate some of the circumstances which led to the rise of that business.

Previous to 1846 Italian tile of light and dark blue were the only tile used for flooring. About that time the writer, with Mr. Joseph Blake, a merchant at Swanton, were stopping at the Pacific hotel, which had a floor of the Italian tile. I remarked to him that our black marble ought to be used in that city for floors instead of the dead blue Italian. He replied, that is so, and you are the one to do it. This little conversation led me to talk the matter up with the marble dealers. All discouraged it on the ground that I could not make them at a price to compete successfully with the Italian. We however succeeded in getting an order at a very low figure for 2000 black 12½ inch tile. This was in the spring of 1848. On returning home measures were at once taken to set in operation what is known as a rubbing bed, for the purpose of rubbing the face and jointing the edges of tile, making them a perfect square and all to a gauge.

This bed consists of a circular cast iron plate about 11 feet in diameter, which is made to revolve horizontally, and the tile are worked and finished on this with sand and water.

In due time this order for tile was filled, which gave good

satisfaction, and it was not long before they were sought for by other dealers. The demand has increased slowly but steadily from year to year, (with slight exceptions,) until they are now introduced into every principal city, and many of the villages of the United States and Canada, and are laid with Italian or Vermont white marble in most of the large hotels or other public buildings.

The texture being fine and hard, renders them very durable. Buildings in which they have been laid for twenty years or more subject to constant use, (as is the case in the principal hotels of New York,) show very few signs of wear, but on the contrary rather improve in appearance as age and use deepen their color.

For many years we confined ourselves to the black marble business alone, but as there was considerable inquiry for white tile to be laid with our black, we therefore, in order to supply this want, took measures to supply ourselves with white tile from the white marble grounds south of us. But at the first we made some mistakes, as we at that time did not know but one kind was about as good as another, if it looked well when finished and ready to lay. But we soon found the softer and more porous kinds were not the thing to make good tile, however white they might be, the great objection to them being that they soon have a dirty and grindy appearance. We have, however, for some years avoided this kind of marble, and furnish only the harder kinds which have given good satisfaction, among which may be mentioned the Brandon, Pittsford, Sutherland Falls and Middlebury.

We have also introduced our new red-white-vein marble into the tile market. This, though hard and expensive, makes, when combined with white and black, a very beautiful floor. Last year we supplied one floor of this kind, costing about $1000, and many other smaller ones of

various fancy patterns. These patterns we have of various kinds to show to those that call, or send to our customers when they request it.

Tile should be made of very even surface and perfectly square. The old process of finishing them by hand was a slow and tedious one. The writer has invented a number of machines for the purpose of lessening the labor of making them, some of which have been of much service, but not entirely satisfactory, until he with his son, then in business with him, invented and took out a patent for a machine for squaring and dressing tile, which has proved very valuable.

The marble business in this section has a sad history. From the time of its commencement in the year 1812, for fifty years, no one that has made that their business can be said to have been successful. But this may be said of most all other kinds of business, say previous to 1850; though possibly a small per cent. have been successful. Even farmers, as may be remembered by some present, once had a hard time of it, but there is hope for the future.

The wealth of the country is rapidly increasing, and as it increases people naturally feel that they can afford marble floors and furniture and the demand for colored marbles will gradually increase. Yet I do not look for a great demand. It never will become a staple article like the Rutland and other lighter colored marbles for the reason that, with the exception of mourning granite, it does not stand the weather without fading, while probably nineteen twentieths, of the lighter colored marbles of Vermont are used for out of door purposes and consequently must take the lead as an article of commerce.

# MINING IN VERMONT.

AN ADDRESS BEFORE A MEETING OF THE STATE BOARD OF AGRICULTURE, MANUFACTURES AND MINING, AT BURLINGTON.

BY HIRAM A. CUTTING, A. M., M. D.,
State Geologist.

*Mr. President, Ladies and Gentlemen:*

In the meetings of this Board, though the principal interests are rightfully directed towards agriculture, as Vermont is truly an agricultural state, yet, as we have a manufacturing and mining interest, represented by a large and constantly increasing capital, it is but just that they should claim attention. It is of our mining interests that I shall speak, not with the flattering terms of a speculator, or a dealer in mining stocks, but with due regard to truth as unfolded by geological science. And while I do not intend in any way to prevent the due development of mines in Vermont, I hope I may discourage useless expenditure, and thus tend to elevate mining from a mere guess to what it in reality is, a true science.

Our mining interests in marble and slate exceed that of most other states; perhaps I might say any others, but in metallic ores, of which I shall more especially speak, our rocks are too old and compact, or too nearly connected with the glacial drift, to have many mines of great value or extent. Our mountains of lead, silver or iron, notwithstand-

ing their traditional substantiation, do not exist in fact. The mining interest of Vermonters is, however, quickly aroused. When I have made enquiries in a place in reference to any mineral, I have frequently heard some old legend about an Indian that obtained lead for bullets from such a mountain, or an old Spaniard who procured a great amount of silver from a certain side hill that they had often looked over in vain, yet believed there was truly a silver mine there. The express frequently brings me sand containing yellow or white mica, while the one sending it indulges the vain hope that it is gold or silver; and white and yellow pyrites in schist rock is quite as often at hand. Now and then, however, a specimen reaches me that really contains galena, or copper pyrites, and sometimes an almost microscopic speck of gold, but of such a quality, or so sparsely scattered, as to be of no value whatever. Though we have much of the early formation, or Eozoic rock, it is in Vermont that the drift agencies come in full play, and it is difficult, many times, to unravel, even by supposition merely, knotty questions that come up as we investigate the drift problems. Drift scratches in the primary rock frequently cross each other, at various angles, and the glacial and iceberg theories must both be called in to remove the difficulties, and even then lingering doubts will creep in that other forces, not well understood, might cause the almost unexplained freaks of geological contradiction. At Brandon the drift is frozen, and after various opinions are expressed and ingenious probabilities formed, such naturalists as Prof. Agassiz say "that it is a fact standing forth, perhaps without true explanation as yet." Here and there what might have been valuable beds of ore, as in Arlington and Manchester, have by this agency been torn from their original positions to be broken and scattered in such small masses as to be nearly worthless,

and well skilled miners are thus foiled, and capital many times wasted. Mining for metallic ores in Vermont, as it has been carried on, has hardly been far removed from a game of chance, and I doubt if all the profits of the truly productive mines would pay for one half of the time and money expended to no purpose. Indications, that in some sections of our globe would lead invariably to valuable mines, pass for nothing in Vermont. Though we have the representative rocks, from the Eozoic to the Tertiary period, sufficient to indicate the possibility of finding any mineral, with the exception of coal, yet they are so compact and closely jointed that truly extensive beds of any ore must be the exception instead of the rule, and for this reason extreme caution is indicated in investments.

It is true that some mines of iron and copper have at certain times, and do still, pay a profit to their owners; yet the record of disaster in comparison is fearfully large. In some sections much money has been expended in the vain search for workable ore in the drift formation. In other sections shafts have been driven, as at Ludlow, where the most common knowledge of geological science would have saved thousands of dollars. With such examples at hand it seems evident that the work of the geologist should be something more than to point out probable mines, and encourage capitalists to make investments for developments, but rather should dissuade rash persons from rushing blindly on, where experience has proved that failures must result. I would in no way depreciate mining with a probability of success, but would reduce this needless expenditure, which in Vermont has been fearfully large.

Gold is widely distributed over the globe, and occurs in rocks of various ages, from the Eozoic to the Tertiary. The schists that contain the auriferous veins were once sed-

imentary beds of clay, sand, or mud, derived from the wear of pre-existing rocks. Through some process in which heat was concerned, the latter were metamorphosed into the hard crystalline schists, and at the same time upturned and broken and often opened between the layers, and then all the fissures cutting across the layers and the openings, (made between the layers, and therefore conforming with the lamination,) became filled with the quartz veins containing gold.* The quartz was brought into the intersecting fissures and the interlaminated open spaces, from the rocks either side, by means of the permeating heated waters, at a temperature probably much above that of boiling water, having thus great decomposing and solvent powers, and carrying into cavities whatever could be gathered up in this manner from the rocks. Thus it will be seen that the gold of the veins was derived from the rocks adjoining the openings, either directly adjoining, or above or below them. According to this idea, which is believed to be correct, it must have been widely distributed through these rocks before they were crystallized and the veins were made, although it existed in so infinitesimal a quantity in a cubic foot, that the beds without this metamorphision and the vein-making would have everywhere been worthless mining ground. As we have before said, gold exists more or less abundantly all over the globe, and in most of the regions of crystalline rocks, especially those of the semi-crystalline schists, like those in central and eastern Vermont, it is sometimes wrought with profit. Those gold-bearing schists are interspersed with quartzy seams and veins, in such a way that the gold miner from Siberia, or even from the Sierra Nevada of our western coast, would pronounce sure indications of richly productive mines. Further, gold actually exists. In some towns

* See Dana's Mineralogy, page 7.

situated in the central talcose schist section, as Plymouth for example, gold has been taken in paying quantities, yet in other sections with little or no success. In 1866, at Bridgewater, quartz mining was carried on to some extent, and the veins seemed more promising than any others in the State, but they were soon given up, though assays from selected ore show from $80 to $100 gold per ton of ore. A regular yield of $10 per ton, with favorable rock to blast, would certainly be profitable, but blasting was not a success in Vermont. In 1868 and '69, certain parties in Lisbon, N. H., on the line of talcose schist, which I have spoken of as being largely prominent in eastern Vermont, formed extensive mining companies, which companies erected two mills, or crushers, for the elimination of the gold from the quartz veins in which it was found. The stories told of the amount of gold obtained would do credit even to the gold regions of California; yet after running a few months the proprietors became involved, and their property was sold at auction at a small percentage of its cost. The present proprietors, after carefully looking over the mining prospect, turn their attention towards agriculture, and believing their interests lie in that direction, crush the rock so poor in gold as to be worthless, and sell it to farmers as a plant food, superior to superphosphate or guano. That they now make profit I do not doubt, but that farmers derive a benefit therefrom, at all proportionate to the price paid, I do doubt, and if chemical science is not in fault, the "Stevens Fertilizer," so called, ground from this rock, is no better than so much fine sand.*

* In the Boston Journal of chemistry, page 89, the editor says: "It seems the Lisbon fertilizer is now fairly pitted against the Grafton, and in the contest it will be interesting to learn whether the silex of the fermer, or the dolomites of the latter shall come out ahead. We give the analysis of these fertilizers, for which we make no charge:

GRAFTON MINERAL FERTILIZER.

| | |
|---|---|
| Silica | 30.30 |

Prof. Collier, in his analysis, may show the "Grafton fertilizer" of more worth.*

But the gold panic did not stop in Lisbon: almost every man that owned a farm within the schist district, felt more or less the gold fever, and nearly all wasted both time and money in the fruitless search. Not because they did not find gold, was it unprofitable, but because they did, and the rocks so compact, with gold so scarce, that while it lured many on like a "will-o-the-wisp," it kept up the excitement in all, which has hardly subsided as yet. It is possible that gold will be found in Vermont in workable quantities. If so, it is probable it will be in the central district, or in sand on the bed rock, as our quartz veins seem too hard to promise well. †A young man in Essex county, brought me a

| | |
|---|---|
| Protoxide of iron | 6.27 |
| Lime | 20.60 |
| Magnesia | 11.17 |
| Carbonic acid | 32.11 |
| | 100.45 |

LISBON, OR STEVENS MINERAL FERTILIZER.

| | |
|---|---|
| Silica | 90.60 |
| Lime | 3.27 |
| Oxide of iron | 3.06 |
| Alumina | .31 |
| Magnesia | .38 |
| Carbonic acid | 1.35 |
| Water | 1.06 |
| Alkalies | a trace. |
| | 100.03 |

Good solid plant food truly. It would be as unreasonable for a baby to turn away from cast iron, as for the grasses and cereal plants to reject such delectable nutriment as is here afforded."

*See Prof. Collier's analysis of the Grafton and Stevens mineral fertilizers.

†Gold has since been found near the village of Gaysville, and it is said the washings pay, and are quite extensive, under the direction of Saltery & Smith, the lessees of an island in White river, near the above mentioned village.

Assays of gold from localities in the vicinity of Gaysville show it to be very pure, a sample from "Locust Creek" containing 94.74 per cent. of gold, and a sample from the "Island" containing 96.53 per cent of gold. P. C.

fine specimen of gold from a rollstone he found, while digging a well, and that specimen cost him much time and money, yet he never after found twenty-five cents worth of gold. Of course it is possible that gold may be found in workable quantities in the quartz of Vermont, but the probabilities are greatly against it. Now when agriculture is as remunerative as in this State, will any reasonable man take that small chance of prospecting our rocks for gold? Better (than to largely invest in quartz mining,) plant corn and use the poorest mineral fertilizer in place of guano, and at the same price, if they must be humbugged.

Chalcopyrite or copper pyrites, a valuable ore in many countries, as England, for the production of copper, has been found in many sections of this State, and new veins are liable to be discovered at any time. Its being wrought with profit, however, in this section, is quite another thing, as it requires the most favorable circumstances for success. Where one venture has yielded a fair compensation, many have been failures, even when the managers have supposed every indication of a favorable character. There appears to be three divisions or belts of copper bearing schists, extending into this State, one in the eastern, one central, and one western. The eastern belt, crossing the Connecticut in the southern part of Essex county, was unknown until 1864, when it was discovered at various points and mined in several places. The most extensive mining operations were carried on in the south part of Concord. A company of New York men purchased the almost barren hill at a cost of about thirty thousand dollars, erected buildings and necessary machinery, expended twenty-five thousand dollars more in mining, obtained about twelve thousand dollars' worth of copper ore, and then abandoned the enterprise. The vein was well situated, but quite variable in thickness,

being sometimes six or seven feet, and again but a few inches, with a hard quartzy, gangue rock. At a depth of about one hundred feet it seemed to run nearly out, or be found only in irregular lodes, and was given up. It is, however, quite probable that other outcrops of Chalcopyrite may be found in the copper divisions of Vermont, that can be wrought with more or less profit, but the history of those previously wrought should lead every one inclined to invest to weigh well the probabilities and take counsel of past experience, as well as to obtain accurate information in relation to the character of the rock, and the probabilities of success derived from geological science. There is an old adage among miners, that "metals never grow in very hard rocks." As is often the case with practical men, the fact, as far as it affects mining, is correct; but of the growth of a mineral, of course, it is obsolete.

As tin, if found at all in Vermont, will doubtless be found in connection with the copper mines, it will be well here to direct our attention to that mineral. Many tin mines now wrought in different sections of this globe were explored for, and several wrought for copper; and in a number of cases it was only several hundred feet from the surface that tin was first met with. Some of the tin mines of Cornwall, which are the richest in tin of any on the globe, were first opened for copper, though after reaching the granitic rock tin was found. In the Vershire copper mine, when visited by myself in 1867, indications of tin in the deepest shaft were quite prominent, and I find the same opinion was expressed when the mine was examined by our State survey in 1859. As a gentleman from Bradford will present a full description of this mine before the meeting, the present prospect of tin will doubtless be discussed.

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As tin in Vermont can hardly be expected unless at the bottom of a copper mine, prospecting for tin on the surface would be useless expenditure.

As regards lead, though we have certain indications which would in some sections make probable the existence of valuable mines when opened, there is very little probability of any richly paying mines in this State. The sulphuret of lead is the principal ore from which the lead of commerce is obtained. Doubtless the most important mines to-day known are those in the States of Illinois, Wisconsin, Missouri, and Iowa. Lead is there found in a porous, magnesian limestone, and all around, in and about that region, it is fissured into caverns and openings of various kinds. Frequently those caverns are found incrusted with beautiful crystals of sulphuret of lead in fantastic forms. We have in Vermont undisturbed beds of Silurian rocks, some of which are nearly identical with the galena, or magnesian limestone of the west; but in these compact and comparatively undisturbed sedimentary rock formations of this State, there is hardly a trace of lead. Some small veins of sulphuret of lead are, however, found in the metamorphic rocks of the State, but in no case as yet in sufficient quantity to warrant any great outlay for its extraction, and I think the ill success of the Thetford hill mine, as well as small veins elsewhere, that have taken tribute from men expecting riches from mining, should prevent any further rash expenditures in this section. Yet as many lead mines exist in metamorphic and even in igneous rocks, should sulphuret of lead be found, it would be well to call science in to aid in an opinion as to its worth.

Silver, if found in workable quantities, will doubtless be in connection with lead; small grains of metallic silver may, however, be found in quartzy veins, but cannot be ex-

pected in workable quantities. A small quantity of silver was found in the Thetford lead mine, and I have now specimens from an unopened vein in Weathersfield that contain silver as well as lead, but it is not in remarkable quantities in either place. It would be well in all cases to assay for silver as well as lead, and though these mines would hardly pay to cupel for silver, others might, as I am informed that one dollar and fifty cents per ton will pay the cost of the Pattinson process. Yet I will further state that workable mines of silver or lead are hardly probable, and all should, therefore, invest with caution. I often have my attention called to white iron pyrites under the supposition that it is silver. That the schist rocks of Vermont will ever afford in their substances large amounts of metallic silver is beyond the range of probability, and all that are sanguine over such specimens would do well to inquire what Dr. S. R. Hall means by "fools' silver,"* before they ask many questions. Disappointments would then be more rare. In quartzy sections the probabilities would be greater, but mica there might lead astray.

As regards iron, it occurs in rocks of all ages in workable quantities, and in nearly every portion of the earth's surface. Of course Vermont, with its mountains and valleys, and variously contorted strata of early formation, would not be likely to be without it. Yet this very early formation of sedimentary rocks tells somewhat against our mines of iron even. It being itself sedimentary, and not at that time as rapidly deposited as at some other periods, the veins do not obtain that extent or thickness that they do in many sections. Again many beds have in part been torn away by drift agency, and broken and scattered by various

* See Hall's Geology, Vermont.

causes, until their extent is rendered problematical, and many times the lode is so small that loss and disappointment to the miner results, as at North Troy and other places. I would also refer to Shaftsbury and Sunderland for further examples, where beds have been nearly all swept away by the drift. As might be expected, the more extensive veins of New York, together with the alteration in character of the gangue rock, rendering the ore more easy of access, and the ore itself less difficult to mine, tends to disparage mining in Vermont. Many ores of iron are, however, found in the State, and many mines have netted a profit to their owners. Among the ores, I would mention the brown oxide or brown hematites, as the most valuable for smelting, and in fine, it is most abundant. Earthy oxide or bog ore, is found in almost every town, usually in small deposits, so small as to be of no real value. We have also the red oxide or red hematite, the black oxide or magnetic iron, as well as the specular oxide, also sulphuret of iron, known as iron pyrites, useless except for copperas and the sulphuric acid manufactory, which brings so low a price in market that it is seldom very profitable to manufacture. We have also spathic ore, and the more valuable chromic iron, which is really of as much value as pig iron, as it is the base of those fine paints known as chrome green, chrome yellow, etc., as well as the bichromate of potash and other salts; it is, however, useless for the furnace. This chrome ore is nearly black; having an uneven fracture, and a dull metallic lustre, it closely resembles specular oxide. It is found in connection with the serpentine of Vermont, or very near it, generally, and I think always thus far, in small veins, or crystalline masses. It seems more abundant in the northern part of the State, and all owning land over the serpentine section would do well to keep an eye out for chromic

iron. If found in sufficient quantity to warrant the manufacture of paints, the high value of the ore would make small beds profitable, as the ore could be sold without outlay for furnaces, etc., and when exhausted, no previous expenditure would be lost. The iron ores of Vermont, as I before said, have been smelted with profit in several places, as at Brandon and Plymouth ; yet there has, doubtless, been more time and money wasted in various attempts to open productive mines, from worthless indications of iron, than all that was ever realized by those that owned successful veins. We can hardly expect to compete with the more valuable mines of Europe, or the mountains of iron in Missouri; yet as freight adds continually to the value of iron, the time will come when we can, probably, produce iron for home consumption at reasonable paying rates. I have no doubt but what many mines of iron now abandoned may be wrought with profit in the future. But all should beware of following worthless indications, or in any way expending money, until science or experience show a probability of success.

Carburet of iron, or plumbago, improperly yet generally known as "black lead," is found in several places in the State, but in small quantities and very impure. Perhaps there is no mineral sought for with such ill success as plumbago. There is often found on slate rocks a black tarnish which soils the fingers, and is taken by many, when found, as a sure indication of "black lead," (as it is termed,) and the ledge is blasted at considerable trouble and expense, when they find less and less of the supposed mineral, until at length the rock becomes compact, and all traces of it are lost, having been at first produced by the decomposition of iron pyrites, which may now be seen in shining cubes in the compact state. Again, such stained places, when dry,

have many times been supposed sure indications of coal, and the ledge mined for that mineral with no better success.

It may be well to say that the early sedimentary rocks of Vermont are altogether too old to contain coal, as they were formed before there was a sufficient soil upon the earth to give root to a vegetation luxuriant enough to leave the debris sufficient to produce the beds of coal, as found in other sections; and our glacial drift period on the other hand too recent to aid in any material formation of the kind.

Though we find at Brandon and some other places a faint effort of recent drift in the production of a kind of lignite, somewhat akin to coal, it is nowhere of great extent, and it is plain that it is entirely useless to expend any money in search of what cannot exist within our borders. Manganese is found in many places in connection with iron ore, and also separate therefrom, and is of use in the arts, bringing a fair price in accordance with its purity. It can never be any great source of profit to Vermont, as it is generally abundant, and it is doubtful if its damage to the smelting process, when mixed with iron ores, is not a greater injury than its value can ever compensate. But the worth of Vermont is not so much in its metallic ores as in its excellent soil, which reaches to the top of all our hills, and I might almost say, our very mountains. In the valleys and in our swamps is the best sphagneous muck, which needs only sufficient trial to become popular as a fertilizer. If, as Dr. Mason said at an agricultural meeting in New Hampshire, "the rocks of New Hampshire are the wealth of the State, as they only need to be pulverized to exceed the superphosphates in fertilizing power," we can safely say the same of our muck beds, which will do as much, and then add the fact, that our rocks are many times more valuable, whether used as monuments, building stone, or as lime to

burn and grind in a discarded gold crusher, to supply the farming community with a valuable, instead of a nearly worthless fertilizer.

I am asked if we need another geological survey of our State? I answer most emphatically that we do: not only to point out where mining operations can be carried on with success, but where they cannot; to enlighten the popular mind, so that the wild schemes of wealth from impossible mines may be crushed, thus saving waste of time and money, which might in agriculture give profitable results, as well as to point out differences in soil in different sections, and act thus as an aid to the farmer in determining what fertilizer is required to bring about the best possible results; to closely define the lines of division between soils of different characters, which can only be fully settled by a close study of all the geological changes which gave us this soil, though differing in different sections, yet found to possess extraordinary fertility everywhere within our limits.

# THE HYDROGRAPHIC SURVEY OF VERMONT.

In the report of the Senate Committee on Agriculture, dated November 21st, 1870, accompanying "An act Establishing a Board of Agriculture, Mining, and Statistics,"—in which report the passage of this act was strongly urged,—among many good results predicted from the labors of such a Board, it was declared that it would "operate to bring before the people full and accurate statistical information in reference to our mines, quarries, mills, and the water-power of the State, which will prove of immediate advantage to the material resources and industries of the State."

The immense importance of this measure, in securing the development of our material resources, can hardly be overestimated; but although it has been a frequent topic of private discussion, it has never, we believe, been brought prominently before the people or our legislature.

Within our borders, and readily accessible, are many water powers comparatively unknown and wholly unimproved, and many others are but partially occupied, which offer to capitalists and manufacturers unsurpassed advantages. Raw material in abundance also exists in various localities, inviting the skill necessary to render it available. A survey, such as is contemplated, by attracting attention to, and thus

bringing into use these immense natural forces now running to waste, will greatly increase our strength and productive power as a community, and cannot but work to the advantage of all classes of our people; furnishing to capitalists knowledge whereby they may make safe and lucrative investments; to laborers a greater variety of occupation; and to producers a ready market. It will prove a permanent benefit to our railroads and other means of transportation. It will furnish to the young men of Vermont abundant opportunity for the full development of their powers, without going beyond her borders. Thus far, for the most part, our rich pastures and farming lands have claimed our care and attention to the comparative neglect of the other interests, while our sister States, with natural facilities certainly not superior to our own, have built up great manufacturing industries, which have added greatly to their population and their wealth. It is high time for Vermont to follow their example.

The importance of this branch of their work has from the first occupied the minds of the Board, and at their first meeting the Secretary was directed to take such steps toward carrying forward an accurate survey of our water powers and manufacturing facilities as should, upon consultation, seem advisable.

Through the courtesy of Walter Wells, Esq., superintendent of the Hydrographic Survey of Maine, information was obtained as to the details of the work, and the methods of its accomplishment, and although without funds sufficient to complete the work, the Secretary has, during the past fifteen months, been collecting material for such report. A circular containing questions (twenty-five in all) relating to the water powers, and other manufacturing facilities, has been sent

to every town in the State, and thus far about one hundred and twenty-five replies have been received. These replies show, what was doubtless known to nearly every citizen of Vermont, though indefinitely, that there exist within our borders water powers, wholly or in part unused, which in extent of power, constancy, and availability, are second to none in New England.

It is not intended that the entire work, necessary to a complete survey of the State, shall be done at the expense of the State, though considerable as would be the amount required to carry through such a survey, we think that our legislature would be justified in making the necessary appropriation. It is thought in many cases, towns and villages, possessing superior water powers, may see it to be for their interest to appropriate small sums for the purpose of having an accurate survey and description of them prepared for publication in the report, thus distributing the expense among those more immediately to be benefited by their development.

Of the returns already reccived, a large number, (more than one-third,) indicate a willingness on the part of parties owning valuable water powers to meet the entire expense of an accurate survey, while others are willing to share the expense of such survey. Of course these surveys cannot be made until an appropriation necessary to secure the publication of the report when completed is assured.

The Maine Hydrographic Survey, already mentioned, is a volume of 525 pages. Part I. (68 pages) is devoted to the Geography, Topography, Meteorology and Climatology of the State. Part II. (82 pages) is taken up in a description of the various "river systems" of the State; while part III. is made up of detailed descriptions of the various "water powers" of the State.

This report of Maine has been placed in the hands of New England capitalists, and the action of many towns, in exempting from taxation for a term of years all capital invested in manufactures, has tended to attract manufacturers and capitalists into the State.

Besides the returns already secured by the Secretary, there are also on hand, and constituting additional material for a speedy report, if it shall be provided for by appropriation, one hundred and forty-one returns to a circular issued by the Secretary of State, under date of January 1st, 1869, the questions upon this circular being similar to those upon the circular issued by the Secretary of the Board of Agriculture, &c.

In nearly every township there are a few persons competent to give the information desired, and there are also extant, although at present unavailable, many accurate reports of surveys made under direction of railroad corporations or local manufacturers, sufficient, when obtained, to furnish a reliable and extensive foundation for such survey as is contemplated.

Of course, it is of extreme importance that this work be done quickly, and that our unsurpassable advantages in these respects be at once made known; and it depends upon the press of the State and public spirited citizens to urge upon the people its importance.

# STATISTICS

OF

# AGRICULTURE OF VERMONT,

FROM THE

## NINTH CENSUS OF THE UNITED STATES,

FOR THE YEAR

1870.

| | COUNTIES. | ACRES OF LAND. Improved. | UNIMPROVED. Woodland. | UNIMPROVED. Other unimproved. | PRESENT CASH VALUE. Of farms. | PRESENT CASH VALUE. Of farming implements and machinery. | Total amount of wages paid during the year, including value of board. | Total (estimated) value of all farm productions, including betterments and additions to stock. | Orchard products. | Produce of market gardens. | Forest Products. | Value of home manufactures. | Value of animals slaughtered, or sold for slaughter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Number.* | *Number.* | *Num.* | *Dollars.* | *Dollars.* | *Dollars.* | *Dollars.* | *Dol'rs.* | *Dol'rs* | *Dollars.* | *Dol'rs.* | *Dollars.* |
| | Total.......... | 3,073,257 | 1,386,933 | 68,613 | 139,367,075 | 5,250,270 | 4,155,385 | 34,647,027 | 682,241 | 42,225 | 1,238,929 | 181,268 | 4,320,619 |
| 1 | Addison.......... | 278,170 | 108,990 | 9,945 | 16,001,518 | 436,446 | 446,580 | 3,055,768 | 42,724 | 3,671 | 118,884 | 3,409 | 431,573 |
| 2 | Bennington....... | 127,006 | 61,079 | 2,385 | 6,340,195 | 211,621 | 208,421 | 1,160,545 | 9,001 | 525 | 23,332 | 1,040 | 88,514 |
| 3 | Caledonia......... | 235,955 | 122,061 | ..... | 8,438,065 | 380,709 | 266,268 | 2,609,673 | 28,186 | 355 | 75,314 | 7,797 | 430,111 |
| 4 | Chittenden........ | 218,670 | 64,970 | 7,055 | 14,783,045 | 491,216 | 482,533 | 3,098,404 | 82,071 | 6,977 | 78,778 | 3,288 | 356,660 |
| 5 | Essex............ | 58,516 | 68,025 | 11,952 | 1,873,965 | 86,706 | 95,015 | 791,092 | 7,346 | ..... | 82,516 | 5,104 | 120,802 |
| 6 | Franklin......... | 276,963 | 112,794 | 8,313 | 16,663,492 | 438,093 | 483,088 | 3,236,782 | 36,496 | 3,800 | 17,203 | 1,086 | 296,933 |
| 7 | Grand Isle........ | 36,872 | 8,889 | 1,081 | 2,579,795 | 74,641 | 76,612 | 497,750 | 18,743 | 1,346 | 12,186 | 278 | 52,660 |
| 8 | Lamoille.......... | 106,638 | 81,542 | 185 | 5,675,180 | 209,453 | 146,409 | 1,520,590 | 24,365 | 150 | 8,795 | 3,830 | 161,518 |
| 9 | Orange ....... ... | 291,318 | 107,951 | 1,473 | 10,205,063 | 338,500 | 215,853 | 2,900,786 | 121,084 | 300 | 88,841 | 2,483 | 383,243 |
| 10 | Orleans.......... | 196,456 | 157,449 | 299 | 8,949,310 | 395,542 | 307,887 | 2,552,519 | 15,219 | 1,840 | 78,829 | 10,835 | 304,020 |
| 11 | Rutland.......... | 301,499 | 120,238 | 19,850 | 14,231,525 | 508,191 | 422,937 | 3,458,102 | 47,567 | 7,400 | 161,958 | 4,200 | 384,185 |
| 12 | Washington....... | 238,113 | 118,403 | 3,135 | 11,305,586 | 565,973 | 332,442 | 3,666,376 | 46,056 | 5,802 | 202,970 | 8,831 | 426,780 |
| 13 | Windham......... | 308,975 | 123,886 | 1,245 | 9,127,096 | 483,621 | 336,992 | 2,619,542 | 103,022 | 7,572 | 118,226 | 4,583 | 417,735 |
| 14 | Windsor......... | 398,106 | 130,657 | 1,686 | 13,193,240 | 629,567 | 334,348 | 3,479,098 | 100,361 | 2,487 | 171,097 | 124,504 | 465,885 |

| | COUNTIES. | PRODUCED. | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | BEES. | |
| | | Hops. | Flax. | Flax seed. | Maple Sugar. | Maple Molasses. | Wax. | Honey. |
| | | *Pounds.* | *Pounds.* | *Bushels.* | *Pounds.* | *Gallons.* | *Pounds.* | *Pounds.* |
| | Total ......... | 527,927 | 12,899 | 444 | 8,894,302 | 12,023 | 5,235 | 142,932 |
| 1 | Addison .......... | 5,220 | ........ | ....... | 201,855 | 150 | 1,076 | 28,977 |
| 2 | Bennington....... | .......... | 12,500 | 439 | 170,268 | 84 | 40 | 445 |
| 3 | Caledonia......... | 31,910 | ........ | ........ | 1,158,904 | 267 | 144 | 7,915 |
| 4 | Chittenden ., ..... | 1 | 40 | 2 | 426,726 | 928 | 839 | 11,301 |
| 5 | Essex............ | 1,820 | 100 | ........ | 178,188 | 40 | 302 | 6,505 |
| 6 | Franklin.......... | 3,130 | ........ | ....... | 830,344 | ........ | 488 | 4,170 |
| 7 | Grand Isle........ | 15,982 | ........ | ........ | 18,845 | ........ | 135 | 5,305 |
| 8 | Lamoille.......... | 68,233 | 45 | ........ | 657,892 | 181 | 354 | 8,399 |
| 9 | Orange........... | 15,930 | ........ | ........ | 816,921 | 3,871 | 207 | 5,719 |
| 10 | Orleans.......... | 254,429 | ........ | ....... | 1,025,502 | ........ | 296 | 9,088 |
| 11 | Rutland.......... | 400 | ........ | ........ | 522,177 | 4,722 | 404 | 25,504 |
| 12 | Washington..... .. | 26,910 | 194 | 1 | 1,109,678 | 314 | 544 | 11,822 |
| 13 | Windham......... | 22,420 | 20 | 2 | 988,444 | 750 | 212 | 7,684 |
| 14 | Windsor .......... | 81,542 | ....... | ........ | 788,558 | 716 | 194 | 9,098 |

| CIVIL DIVISIONS. | Improved land | Value of farms and farming implements. | Value of live stock. | Value of all productions. | Hay. |
|---|---|---|---|---|---|
| ADDISON. | Acres. | Dollars. | Dollars. | Dollars. | Tons. |
| Addison | 20,222 | 1,083,495 | 165,143 | 206,975 | 8,337 |
| Bridport | 21,500 | 1,436,903 | 190,863 | 209,712 | 9,048 |
| Bristol | 8,038 | 584,822 | 80,030 | 115,676 | 3,202 |
| Cornwall | 15,398 | 967,923 | 113,227 | 165,873 | 6,004 |
| Ferrisburgh | 20,712 | 1,423,565 | 188,230 | 257,991 | 8,670 |
| Lincoln | 10,183 | 491,909 | 95,110 | 121,109 | 3,647 |
| Middlebury | 16,585 | 1,387,280 | 127,780 | 163,333 | 6,622 |
| Monkton | 13,149 | 937,820 | 131,390 | 193,076 | 5,490 |
| New Haven | 18.612 | 1,238,010 | 159,080 | 246,005 | 8,638 |
| Orwell | 21,315 | 1,076,913 | 176,628 | 227,805 | 9,278 |
| Shoreham | 23,763 | 1,282,449 | 199,458 | 258,162 | 10,981 |
| Starksboro | 12,027 | 908,714 | 149,920 | 187,275 | 5,750 |
| BENNINGTON. | | | | | |
| Arlington | 10,576 | 495,045 | 66,478 | 107,151 | 2,618 |
| Bennington | 17,366 | 1,925,339 | 148,330 | 199,840 | 4,876 |
| Pownal | 21,010 | 845,465 | 119,875 | 198,893 | 5,120 |
| Rupert | 16,891 | 739,099 | 109,285 | 134,410 | 4,545 |
| Shaftsbury. | 17,590 | 787,598 | 110,125 | 174,311 | 4,545 |
| CALEDONIA. | | | | | |
| Barnet | 19,117 | 771,871 | 157,992 | 231,023 | 6,101 |
| Burke | 12,924 | 437,088 | 96,205 | 139,814 | 3,713 |
| Danville | 26,063 | 980.248 | 185,625 | 298,813 | 7,054 |
| Hardwick | 15,915 | 958,100 | 146,408 | 243,557 | 5,517 |
| Lyndon | 18,749 | 836,520 | 152,571 | 187,997 | 5,517 |
| Peacham | 15,455 | 551,978 | 114,053 | 191,455 | 4,480 |
| Ryegate | 14,433 | 544,675 | 133,425 | 197,336 | 5,066 |
| St. Johnsbury | 20,060 | 846,402 | 136,924 | 222,560 | 5,516 |
| Sutton | 13,229 | 376,165 | 67,026 | 106,260 | 2,088 |
| Walden | 12,585 | 438,005 | 88,573 | 147,834 | 3,707 |
| Waterford | 17,197 | 610,440 | 141,430 | 184,378 | 4,958 |
| Wheelock | 12,938 | 401,186 | 75,008 | 128,044 | 2,919 |
| CHITTENDEN. | | | | | |
| Charlotte | 21,672 | 1,693,040 | 194,675 | 312,150 | 7,663 |
| Colchester | 14,651 | 2,164,675 | 122,435 | 213,512 | 5,070 |
| Essex | 17,065 | 1,180,580 | 166,409 | 230,505 | 7,157 |
| Hinesburgh | 18,361 | 1,242,195 | 195,535 | 275,428 | 7,543 |

| CIVIL DIVISIONS. | Improved land | Value of farms and farming Implements. | Value of live stock. | Value of all productions. | Hay. |
|---|---|---|---|---|---|
| CHITTENDEN. Continued. | *Acres.* | *Dollars.* | *Dollars.* | *Dollars.* | *Tons.* |
| Huntington.... | 11,484 | 650,570 | 114,965 | 135,820 | 4,306 |
| Jericho........ | 15,392 | 1,206,090 | 164,698 | 253,573 | 5,894 |
| Milton......... | 23,304 | 1,322,690 | 202,564 | 293,855 | 7,978 |
| Richmond...... | 14,648 | 979,921 | 158,275 | 236,157 | 5,260 |
| Shelburne...... | 11,639 | 1,080,320 | 109,495 | 159,645 | 4,998 |
| Underhill...... | 16,596 | 884,245 | 157,540 | 225,465 | 6,019 |
| Westford....... | 15,941 | 876,715 | 170,187 | 224,407 | 6,453 |
| Williston...... | 17,190 | 1,204,660 | 170,555 | 258,908 | 6,303 |
| ESSEX. | | | | | |
| Concord....... | 15,458 | 541,676 | 119,897 | 196,772 | 4,395 |
| Lunenburgh... | 12,484 | 397,140 | 72,263 | 174,491 | 4,394 |
| FRANKLIN. | | | | | |
| Bakersfield.... | 15,777 | 916,890 | 126,716 | 164,744 | 5,524 |
| Berkshire..... | 16,608 | 1,119,195 | 190 340 | 294,169 | 7,716 |
| Enosburg...... | 18,050 | 1,179,660 | 190,270 | 304,897 | 7,760 |
| Fairfax........ | 19,731 | 1,309,540 | 179,748 | 238,589 | 7,643 |
| Fairfield....... | 31,295 | 1,813,648 | 286,193 | 391,449 | 12,619 |
| Fletcher....... | 12,264 | 626,168 | 101,585 | 135,207 | 4,219 |
| Franklin....... | 15,903 | 1,123,590 | 149,420 | 258,748 | 6,936 |
| Georgia....... | 21,038 | 1,300,624 | 145,480 | 250,263 | 7,976 |
| Highgate...... | 18,729 | 1,229,775 | 146,521 | 235,544 | 8,643 |
| Montgomery... | 8,647 | 625,220 | 86,949 | 137,670 | 3,715 |
| Richford....... | 10,135 | 616,350 | 102,750 | 162,331 | 4,373 |
| Sheldon........ | 15,058 | 1,101,600 | 145,871 | 144,172 | 6,444 |
| St. Albans..... | 53,964 | 2,873,125 | 292,862 | 328,674 | 11,466 |
| Swanton....... | 19,764 | 1,266,200 | 149,365 | 190,325 | 9,041 |
| GRAND ISLE. | | | | | |
| Alburgh....... | 11,849 | 932,265 | 101,307 | 165,131 | 5,421 |
| Grand Isle..... | 8,895 | 647,407 | 68,966 | 109,514 | 1,761 |
| LAMOILLE. | | | | | |
| Cambridge..... | 18,852 | 1,199,500 | 183,204 | 265,416 | 7,487 |
| Eden.......... | 8,573 | 319,167 | 65,319 | 106,930 | 2,949 |
| Elmore........ | 6,779 | 284,790 | 64,394 | 108,202 | 2,726 |
| Hydepark..... | 11,223 | 606,411 | 115,922 | 162,175 | 4,638 |
| Johnson....... | 13,110 | 714,050 | 110,525 | 156,993 | 5,723 |
| Morristown.... | 15,101 | 858,630 | 179,958 | 244,864 | 5,934 |
| Stowe......... | 17,219 | 1,081,075 | 198,633 | 267,940 | 6,509 |
| Wolcott....... | 9,044 | 523,965 | 93,886 | 145,282 | 3,599 |

| CIVIL DIVISIONS. | Improved land | Value of farms and farming implements. | Value of live stock. | Value of all productions. | Hay. |
|---|---|---|---|---|---|
| **ORANGE.** | *Acres.* | *Dollars.* | *Dollars.* | *Dollars.* | *Tons.* |
| Bradford | 13,025 | 541,270 | 80,209 | 119,599 | 4,136 |
| Braintree | 12,837 | 502,150 | 98,870 | 177,282 | 4,140 |
| Brookfield | 17,728 | 784,030 | 160,337 | 252,043 | 6,193 |
| Chelsea | 18,419 | 612,875 | 159,288 | 212,214 | 6,049 |
| Corinth | 22,131 | 625,004 | 122,323 | 168,750 | 6,412 |
| Newbury | 24,838 | 878,151 | 158,621 | 208,602 | 6,896 |
| Orange | 13,088 | 400,171 | 84,511 | 120,533 | 4,001 |
| Randoph | 24,439 | 1,405,631 | 249,903 | 390,101 | 8,991 |
| Strafford | 21,485 | 571,935 | 109,620 | 140,593 | 4,719 |
| Thetford | 19,376 | 898,342 | 138,048 | 179,600 | 5,767 |
| Topsham | 18,127 | 488,628 | 112,896 | 145,705 | 4,981 |
| Tunbridge | 20,695 | 685,290 | 137,260 | 175,124 | 5,612 |
| Vershire | 14,283 | 362,120 | 94,356 | 112,953 | 4,286 |
| Washington | 17,324 | 447,201 | 103,437 | 139,701 | 4,797 |
| Williamstown | 17,642 | 782,620 | 175,122 | 241,037 | 6,134 |
| **ORLEANS.** | | | | | |
| Albany | 15,2°9 | 703,392 | 122,125 | 185,376 | 3,982 |
| Barton | 13,463 | 826,635 | 116,961 | 171,653 | 4,932 |
| Brownington | 8,369 | 417,715 | 73,928 | 112,466 | 2,952 |
| Charleston | 11,894 | 525,625 | 102,100 | 160,638 | 3,941 |
| Coventry | 10,795 | 573,976 | 105,054 | 154,038 | 4,704 |
| Craftsbury | 14,510 | 683,852 | 125,597 | 168,684 | 4,537 |
| Derby | 14,364 | 860,378 | 139,837 | 225,398 | 5,080 |
| Glover | 15,203 | 607,685 | 129,555 | 175,605 | 5,011 |
| Greensboro | 12,438 | 579,289 | 109,358 | 157,080 | 4,099 |
| Holland | 8,137 | 342,705 | 66,746 | 102,775 | 2,945 |
| Irasburgh | 13,168 | 594,560 | 112,378 | 184,186 | 4,988 |
| Newport | 11,225 | 616,759 | 111,378 | 173,959 | 5,107 |
| Troy | 11,692 | 655,466 | 111,615 | 172,917 | 4,731 |
| **RUTLAND.** | | | | | |
| Benson | 19,401 | 778,850 | 113,709 | 163,160 | 7,825 |
| Brandon | 17,196 | 1,299,840 | 153,375 | 169,515 | 7,624 |
| Castleton | 17,155 | 745,095 | 117,955 | 179,680 | 5,570 |
| Clarendon | 16,511 | 898,569 | 138,941 | 193,134 | 6,041 |
| Danby | 15,637 | 711,200 | 135,390 | 244,137 | 8,526 |
| Middletown | 9,868 | 402,380 | 75,420 | 109,240 | 3,126 |
| Mount Holly | 15,663 | 482,255 | 122,886 | 190,956 | 5,540 |
| Pawlet | 18,487 | 1,053,690 | 146,525 | 242,450 | 6,381 |
| Pittsford | 20,594 | 1,375,165 | 176,531 | 219,280 | 8,596 |
| Poultney | 15,710 | 781,045 | 116,177 | 181,324 | 5,183 |
| Rutland | 17,227 | 1,441,675 | 150,263 | 297,763 | 7,861 |
| Shrewsbury | 15,156 | 573,635 | 114,712 | 157,311 | 4,880 |

| CIVIL DIVISIONS. | Improved land | Value of farms and farming implements. | Value of live stock. | Value of all productions. | Hay. |
|---|---|---|---|---|---|
| **RUTLAND.** Continued. | *Acres.* | *Dollars.* | *Dollars.* | *Dollars.* | *Tons.* |
| Tinmouth | 11,335 | 441,975 | 93,545 | 140,880 | 3,647 |
| Wallingford | 13,886 | 656,685 | 107,608 | 202,468 | 5,155 |
| West Haven | 11,411 | 433,065 | 76,045 | 113,490 | 4,053 |
| **WASHINGTON.** | | | | | |
| Barre | 19,194 | 1,202,085 | 178,719 | 306,092 | 6,661 |
| Berlin | 15,950 | 795,610 | 121,132 | 256,759 | 5,361 |
| Cabot | 16,184 | 763,665 | 141,880 | 230,223 | 5,373 |
| Calais | 16,292 | 844,996 | 142,636 | 256,552 | 5,446 |
| Duxbury | 9,012 | 456,515 | 81,364 | 131,376 | 2,956 |
| E. Montpelier | 14,308 | 926,360 | 146,499 | 253,420 | 5,527 |
| Fayston | 7,865 | 329,750 | 77,277 | 125,896 | 3,716 |
| Marshfield | 13,244 | 619,817 | 120,441 | 202,696 | 4,626 |
| Middlesex | 12,805 | 584,876 | 101,353 | 195,909 | 4,208 |
| Moretown | 14,110 | 715,020 | 127,268 | 209,808 | 4,907 |
| Northfield | 18,133 | 642,342 | 117,639 | 245,145 | 5,913 |
| Plainfield | 7,817 | 386,820 | 71,647 | 124,278 | 2,857 |
| Roxbury | 10,310 | 303,837 | 62,947 | 147,655 | 3,289 |
| Waitsfield | 11,209 | 608,285 | 120,857 | 190,152 | 4,291 |
| Warren | 12,133 | 452,151 | 107,095 | 171,456 | 4,393 |
| Waterbury | 18,719 | 1,249,666 | 183,908 | 308,800 | 7,229 |
| Woodbury | 10,894 | 378,547 | 75,778 | 139,773 | 3,170 |
| Worcester | 7,380 | 312,852 | 53,865 | 103,444 | 2,482 |
| **WINDHAM.** | | | | | |
| Brattleboro | 16,494 | 1,020,125 | 170,209 | 176,896 | 4,943 |
| Dummerston | 13,953 | 543,660 | 111,464 | 129,839 | 3,829 |
| Grafton | 17,847 | 389,314 | 79,895 | 105,684 | 3,715 |
| Guilford | 18,090 | 523,330 | 109,907 | 135,877 | 4,475 |
| Halifax | 19,886 | 363,610 | 104,135 | 149,969 | 4,775 |
| Jamaica | 18,493 | 396,341 | 106,280 | 127,886 | 4,377 |
| Marlboro | 14,463 | 289,995 | 89,862 | 116,833 | 3,596 |
| Newfane | 15,005 | 401,871 | 97,240 | 143,488 | 3,820 |
| Putney | 12,493 | 624,985 | 125,116 | 145,916 | 3,694 |
| Rockingham | 19,359 | 822,420 | 141,538 | 161,413 | 5,088 |
| Townsend | 20,825 | 466,062 | 107,062 | 138,177 | 4,809 |
| Vernon | 7,257 | 429,380 | 51,705 | 100,190 | 2,065 |
| Westminster | 21,319 | 963,101 | 174,240 | 213,340 | 6,277 |
| Whitingham | 15,444 | 412,640 | 114,932 | 141,547 | 5,375 |
| Wilmington | 15,825 | 593,210 | 148,307 | 165,226 | 6,046 |
| **WINDSOR.** | | | | | |
| Barnard | 17,314 | 525,263 | 92,790 | 107,187 | 4,942 |
| Bethel | 17,548 | 624,185 | 101,065 | 147,995 | 4,763 |

| CIVIL DIVISIONS. | Improved land | Value of farms and farming implements. | Value of live stock. | Value of all productions. | Hay. |
|---|---|---|---|---|---|
| WINDSOR. Continued. | *Acres.* | *Dollars.* | *Dollars.* | *Dollars.* | *Tons.* |
| Bridgewater... | 16,791 | 392,780 | 80,150 | 133,900 | 3,620 |
| Cavendish...... | 15,110 | 461,730 | 83,125 | 137,150 | 3,213 |
| Chester........ | 25,095 | 859,640 | 136,370 | 195,507 | 6,196 |
| Hartford....... | 17,464 | 855,430 | 147,990 | 168,434 | 5,898 |
| Hartland....... | 21,525 | 908,071 | 159,466 | 237,240 | 7,452 |
| Ludlow........ | 12,803 | 447,015 | 95,040 | 140,950 | 3,510 |
| Norwich....... | 20,637 | 705,195 | 123,781 | 169,626 | 5,596 |
| Plymouth...... | 15,845 | 353.600 | 85,550 | 137,875 | 3,446 |
| Pomfret........ | 18,450 | 687,178 | 118,152 | 166,445 | 5,750 |
| Reading....... | 16,280 | 391,410 | 77,335 | 105,176 | 4,062 |
| Rochester ..... | 18,885 | 654,295 | 121,528 | 159,015 | 6,230 |
| Royalton ...... | 17,974 | 772,457 | 131,942 | 189,391 | 5,297 |
| Sharon........ | 19,076 | 450,342 | 93,197 | 103,361 | 4,257 |
| Springfield..... | 27,188 | 1,125,895 | 175,485 | 273,628 | 7,628 |
| Stockbridge.... | 14,461 | 456,960 | 90,196 | 108,640 | 3,870 |
| Weathersfield.. | 21,851 | 876,946 | 138,959 | 202,503 | 6,234 |
| Weston........ | 12,082 | 282,365 | 81,500 | 122,930 | 3,718 |
| West Windsor. | 12,969 | 455,490 | 76,990 | 106,757 | 3,514 |
| Woodstock..... | 16,614 | 851,310 | 154,464 | 171,270 | 6,394 |

| COUNTIES. | NUMBER OF FARMS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Of all sizes. | Under 3 acres. | 3 and under 10. | 10 and under 20. | 20 and under 50. | 50 and under 100. | 100 and under 500. | 500 and under 1,000. | 1,000 and over. |
| Total.... | 33,827 | 88 | 1,719 | 1,998 | 6,210 | 10,761 | 12,934 | 102 | 15 |
| Addison ..... | 2,824 | 14 | 254 | 195 | 510 | 697 | 1,129 | 25 | ... |
| Bennington.. | 1,447 | 4 | 82 | 102 | 278 | 368 | 601 | 11 | 1 |
| Caledonia.... | 2,821 | 14 | 174 | 184 | 508 | 953 | 984 | 4 | ... |
| Chittenden .. | 2,130 | 5 | 93 | 125 | 390 | 601 | 904 | 10 | 2 |
| Essex........ | 730 | 1 | 23 | 43 | 181 | 256 | 224 | 2 | ... |
| Franklin .... | 2,396 | 2 | 99 | 97 | 381 | 696 | 1,095 | 18 | 8 |
| Grand Isle... | 319 | ..... | ...... | ...... | 43 | 112 | 164 | .... | ... |
| Lamoille .... | 1,610 | ..... | 69 | 134 | 440 | 592 | 374 | 1 | ... |
| Orange...... | 3,355 | 7 | 117 | 188 | 567 | 1,202 | 1,269 | 5 | ... |
| Orleans ..... | 2,936 | 13 | 213 | 257 | 791 | 955 | 703 | 4 | ... |
| Rutland..... | 2,788 | 4 | 151 | 126 | 418 | 766 | 1,311 | 10 | 2 |
| Washington . | 3,096 | 11 | 144 | 188 | 627 | 1,181 | 945 | .... | ... |
| Windham ... | 3,162 | 12 | 168 | 164 | 473 | 913 | 1,424 | 7 | 1 |
| Windsor .... | 4,213 | 1 | 132 | 195 | 603 | 1,469 | 1,807 | 5 | 1 |

# AGRICULTURAL SOCIETIES IN VERMONT.

| NAME OF SOCIETY. | PRESIDENT. | ADDRESS. | SECRETARY. | ADDRESS. |
|---|---|---|---|---|
| State Agricultural Society and Wool Growers' Association | Henry G. Root | Bennington, | Henry Clark | Rutland. |
| State Board of Agriculture, Manufactures, and Mining | The Governor | Middlebury, | Peter Collier | Burlington. |
| Vermont Dairymen's Association | E. D. Mason | Richmond, | O. S. Bliss | Georgia. |
| Bee Keepers' Association | Middleton Goldsmith | Rutland, | O. C. Wait | West Georgia. |
| Vermont Horse Stock Company | Henry G. Root | Bennington, | L. L. Tucker | Royalton. |
| Black River Valley Agricultural and Mechanical Society | Ira D. R. Collins | Craftsbury, | Nelson Rand | Craftsbury. |
| Champlain Valley Horticultural Society | L. M. Hagar | Burlington, | C. G. Pringle | Charlotte. |
| White River Valley Agricultural Society | Crosby Miller | Pomfret, | Lorenzo Kent | Woodstock. |
| Addison County Agricultural Society | George Hammond | Middlebury, | Albert Chapman | Middlebury. |
| Bennington County Agricultural Society | H. W. Putnam | Bennington, | W. H. Cook | Bennington. |
| Caledonia County Agricultural Society | Charles A. Sylvester | St. Johnsbury, | Isaac W. Sanborn | Lyndonville. |
| Caledonia County Wool Growers and Sheep Breeders' Association | H. M. Hall | East Burke, | Isaac W. Sanborn | Lyndonville. |
| Chittenden County Agricultural Society | A. J. Crane | Burlington, | H. N. Newell | Shelburne. |
| Essex County Agricultural Society | John W. Hartshorn | Lunenburgh, | Charles E. Benton | Guildhall. |
| Franklin County Agricultural and Mechanical Society | J. Gregory Smith | St. Albans, | J. W. Stufflebean | East Sheldon. |
| Lamoille County Agricultural and Mechanical Society | Alger Jones | Morrisville, | E. E. Allen | Morrisville. |
| Orleans County Agricultural Society | Henry C. Cleveland | Coventry, | Zuar E. Jameson | Irasburgh. |
| Rutland County Agricultural Society | Henry F. Lathrop | Pittsford, | Miner Hilliard | Rutland. |
| Washington County Agricultural Society | Edward A. Eldridge | Warren, | A. D. Arms | East Montpelier. |
| Windham County Agricultural Society | George Campbell | Westminster, | W. A. Stedman | Newfane. |
| Windsor County Agricultural Society | Justin F. McKenzie | Woodstock, | Lorenzo Richmond | Woodstock. |
| Braintree Farmers' Club | William H. Nichols | Braintree, | John S. Nichols | West Randolph. |
| Brandon Farmers and Mechanics' Club | C. L. Case | Brandon, | J. F. McCollom | Brandon. |
| Chester Farmers' Club | Joseph P. Barnes | Chester, | J. S. Adams | North Chester. |
| Glover Farmers and Mechanics' Club | C. C. Hardy | Glover, | N. B. Davis | Glover. |
| Grafton Farmers' Club | S. D. Conaut | Grafton, | J. H. Putnam | Grafton. |
| Lower Waterford Farmers' Club | B. D. Brown | Lower Waterford, | A. B. Goss | Lower Waterford. |
| Orwell Farmers' Club | J. B. Cook | Orwell, | C. F. Branch | Orwell. |
| Passumpsic Farmers' Club | E. A. Parks | Passumpsic, | Jonathan Lawrence | Passumpsic. |
| Randolph Farmers' Club | McKinster Eddy | Randolph, | George F. Nutting | Randolph. |
| South Burlington Farmers' Club | John E. Smith | South Burlington, | Dennis F. Fish | South Burlington. |
| West Marshfield Agricultural Society | C. W. H. Dwinell | Marshfield, | A. M. Bullock | Marshfield. |
| Westminster Agricultural Society | N. G. Pierce | Westminster, | Clark Chase | Westminster. |
| Westminster Farmers' Club | M. W. Davis | Westminster, | I. B. Morse | Westminster. |
| Weybridge Farmers' Club | Samuel James | Weybridge, | H. B. Hagar | Weybridge. |
| Wilmington Agricultural Society | Nathan Stark | Wilmington, | O. E. Butterfield | Wilmington. |

# REPORT

OF THE

# STATE GEOLOGIST

AND

## CURATOR OF THE STATE CABINET.

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*To His Excellency* JULIUS CONVERSE, *Governor of Vermont:*

SIR:—I have the honor to present you herewith the report of my management as State Geologist and Curator of the State Cabinet, since my appointment in 1870.

Through the inadvertence of the Secretary of the Senate for that year, the bill making a small appropriation for the improvement of the Cabinet, after passing both House and Senate, failed to reach the Governor in season for his signature and approval, thus apparently defeating the object in view, which object was the preservation of specimens already in the Cabinet, and the addition of such specimens as in my judgment I thought best to add thereto. Feeling that the passage of this bill by the Assembly gave me a sufficient guarantee, I have acted upon the intention of the bill, doing such work as I deemed necessary to preserve the specimens then in the Cabinet, and putting up in a proper manner as many specimens of the Ornithology, Oology, Craniology, Entomology, Conchology and Mineralogy of the State as I thought of sufficient value to warrant the outlay,

until my prospective funds were exhausted. Of the birds of Vermont I have added the following specimens:

No. of Specimens.

## ORDER 1. RAPTORES, ROBBERS.

8......Astur atricapillus................Bon........Gos Hawk.

2......Falco Cooperi.................Thomp........Cooper's Hawk.

1...... " sparverius. .................Lin........Sparrow Hawk.

1...... " niger.......................Wil........Black Hawk.

2...... " borealis ................Thomp........Red tailed Hawk.

4...... " pennsylvanicus ........Thomp........Broad winged Hawk,

3...... " leucocephalus..........Thomp........Golden Eagle.

1......Accipiter fuscus ..................Lin........Sharped shinned Hawk.

8......Pandion carolinensis.............Bon........American Fish Hawk.

2......Nyctale acadica ..................Bon........Saw whet Owl.

2......Strix virginiana,..............Thomp........Great horned Owl.

1...... " asio.......................Thomp........Screech Owl.

2...... " americana...............Thomp........Barn Owl.

2...... " nyctea...................Thomp........Snowy Owl,

2......Syrnium nebulosum............Gray........Barred Owl.

## ORDER 2. SCANSORES, CLIMBERS.

2......Coccygus erythrophthalmus.....Bon........Black billed Cuckoo.

2......Picus villosus .......................Lin........Hairy Woodpecker. M. & F.

2...... " pubescens ..................Lin........Downy Woodpecker.

2......Sphyrapicus varius.............Baird........Yellow bellied Woodpecker. M. & F.

4......Melanerpes erythrocephalus..Swain........Red headed Woodpecker. M. & F.

1......Colaptes auratus...............Swain........Golden winged Woodpecker.

## ORDER 3. INSESSORES, PERCHERS.

6......Trochilus...........................Lin........Hummingbird, M. & F.

8......Chaetura pelasgia..............Steph........Chimney Swift. M. & F.

2......Antrostomus vociferus...........Bon........Whippoorwill.

2......Ceryle alcyon.....................Boie........Belted Kingfisher. Male.

1......Sayornis fuscus...................Baird........Pewee, or Phebe-bird.

1......Empidonax minimus...........Baird........Small Flycatcher.

2......Turdus pallasii....................Cab........Hermit Thrush. M. & F.

1...... " fuscescens..............Steph........Wilson's Thrush.

2...... " migratorius...............Lin........Robin. M. & F.

1......Gallinula galeata.................Bon........Florida Gallinules.

1......Sialia sialis......................Baird........Blue Bird. Female.

1......Parus atricapillus.................Lin........Chickadee.

2......Sitta carolinensis...............Gmel........White bellied Nuthatch.

2......Certhia americana................Bon........American Creeper.

1......Parula americana.................Bon........Blue yellow backed Warbler.

1......Geothlypis trichas................Cab........Maryland Yellow Throat. M.

1......Dendroica canadensis ...........Baird........Black throated Blue Warbler.

No. of Specimens.

## ORDER 3—CONTINUED.

1...... " coronata............Gray........Yellow rumped Warbler. Male.
4...... " Blackburniae.......Baird........Blackburnian Warbler. M.
2...... " striata..............Baird........Black poll Warbler.
1......Euthlypis canadensis............Cab........Canada fly-eating Warbler.
2......Setophaga ruticilla............Swain........Redstart.
2......Pyranga rubra..................Vieil........Scarlet Tanager. M. & F.
2......Hirundo lunifrons................Say........Cliff Swallow.
1...... " bicolor.................Vieil........White bellied Swallow.
3......Progne subis....................Beard........Purple Martin. M. & F.
2......Ampelis cedrorum.............Beard........Cedar Bird.
1......Collyrio borealis................Beard........Northern Shrike.
1......Vireo gilvus......................Bon........Warbling Vireo.
1......Pinicola canadensis..............Cab........Pine Grosbeak.
1......Carpodacus purpureus..........Gray........Purple Finch.
4......Chrysomitris tristis.............Bon........Yellow Bird.
1...... " pinus..............Bon........Pine Finch.
2......Curvirostra americana...........Wil........Red Crossbill. M. & F.
1...... " leucophrys...........Wil........White winged Crossbill.
3......Ægiothus linaria.................Cab........Lesser Redpoll.
1......Plectrophanes nivalis.........Meyer........Snow Bunting.
1......Zonotrichia leucoprys..........Swain........White crowned Sparrow.
1...... " albicollis.............Bon........White throated Sparrow.
1......Junco hyemalis,..................Scla........Snow Bird.
1......Spizella socialis..................Bon........Chipping Sparrow.
4......Melospiza melodia.............Baird........Song Sparrow.
2......Guiraca ludoviciana...........Swain........Rose breasted Grosbeak.
1......Cyanospiza cyanea.............Baird........Indigo Bird.
5......Dolichonyx oryzivorus........Swain........Bobolink. M. & F.
5......Agelaius phœniceus.............Vieil........Red winged Blackbird.
2......Sturnella magna...............Swain........Meadow Lark.
2......Icterus Baltimore................Dan........Baltimore Oriole. M. & F.
1......Scolecophagus ferrugineus....Swain........Rusty Blackbird.
1......Quiscalus purpureus............Licht........Purple Grakle.
2......Corvus americanus..............Aud........Crow.
5......Cyanurus cristatus.............Swain........Blue Jay. M. & F.
1......Perisoreus canadensis...........Bon........Canada Jay.
1......Fringilla canariensis...........Vieill........Canary Bird.

## ORDER 4. RASORES, SCRATCHERS.

2......Ectopistes migratoria.........Swain........Wild Pigeon.
1......Tetrao canadensis........ .......Lin........Spruce Patridge.
2......Bonasa umbellus................Steph........Ruffed Grouse.

## ORDER 5. GRALLATORES, WADERS.

1......Botaurus lentiginosus..........Steph........Bittern.
1......Butorides virescens..............Bon........Green Heron.

### ORDER 5—CONTINUED.

| No. of Specimens. | | | |
|---|---|---|---|
| 1 | Philohela minor | Gray | American Woodcock. |
| 1 | Gallinago Wilsonii | Bon | Wilson's Snipe. |
| 1 | Gambetta melanoleuca | Bon | Teltale Tatler. |
| 1 | Actiturus bartramius | Bon | Upland Plover. |

### ORDER 6. NATATORES, SWIMMERS.

| | | | |
|---|---|---|---|
| 2 | Bernicla canadensis | Boie | Canada Goose. M. & F. |
| 1 | Anas obscura | Gmelin | Black Duck. |
| 1 | Aix sponsa | Boie | Summer or Wood Duck. |
| 1 | Anas albeola | Thomp | Dipper Duck. Female. |
| 1 | " perspicillata | Thomp | Butter Bill Duck. |
| 1 | Mergus americanus | Cas | Sheldrake. |
| 1 | Larus marinus | Lin | Great Gull. Female. |
| 1 | Chroicocephalus philadelphia | Law | Bonaparte's Gull. |
| 4 | Colymbus torquatus | Brun | Loon. M. & F. |
| 1 | " septentrionalis | Lin | Red throated Diver. |
| 1 | Podiceps griseigena | Gray | Red necked Grebe. |

### DOMESTIC FOWLS.

| | | |
|---|---|---|
| 1 | Pavo cristatus | Peacock. Male. |
| 1 | Gallus | Spanish Fighting Cock. |
| 1 | Columba | Dove. |

There are also a few specimens of value belonging to the Thompson collection, but those are chiefly valuable, as being the specimens described in his work, as types of Vermont birds at that time. Their plumage is somewhat faded, and as they were intended for scientific use, instead of exhibition, they are not stuffed to nature, and are little better than bird skins. Their age prevents the possibility of putting them up in a manner for favorable exhibition, and for that reason most of them are of small value to the cabinet. As it is my intention to add types of all the species of Vermont birds, any birds killed in the State not on this list, if in good plumage, and not injured by shooting, I should be glad to receive, either by express or otherwise, for the cabinet. Such as we have on this list not being of as much value, I would request that the friends of this enterprise

would not forward them, unless in some way they were thought to be very fine specimens. The express bills on useless birds retard our work, as it is needless expense taken from a limited fund. I will further state, for the benefit of those interested, that birds to be of value as specimens must be in winter plumage as much as possible, and our migratory birds must be killed as soon as possible after their arrival, or just before their departure. Summer specimens are of no value whatever.

## OOLOGY.

Our collection of birds' eggs is limited, and we desire for the present that all the friends of this collection would save us as many eggs as possible. If the eggs are found early it is but a minute's work to perforate the ends with a needle and blow out the contents; if incubation has progressed so far that the contents cannot be blown out, with a sharp pointed knife, or a thin fine file, a square can be cut out of the side, and the contents broken up and washed out. The piece of shell cut out can be put in place and held there with a drop of mucilage applied inside, so as to flow around the piece cut out; a drop of varnish is even better. The shell must be dry before the application of either.

## CRANIOLOGY.

In this department I have added forty-five specimens. With the exception of Canis lupus, Lin., (common Wolf;) Felis concolor, (Catamount,) we have a complete set of the skulls of Vermont mammals. Any one sending us either of the skulls above mentioned will confer a great favor. As we have only a limited number of the skulls of birds, all will be acceptable for some years to come. To those not accustomed to cleansing bones I would say, that after boiling in clear water for a sufficient time to remove

the muscles, they may be set away for a few days to soak in a solution of sal soda and water, made by dissolving four ounces of the salt to one gallon of water; then after boiling in the same until the bone seems to soften upon the outside, but not enough to destroy any portion of its surface, wash out and lay in the sun to bleach. For small skulls much less time is required.

## ENTOMOLOGY.

I have collected several hundred insects, and have received a few from other parties by exchanges. A full set of entomological specimens representing Vermont species must be the work of years, and I would ask the co-operation of all within the State that are in any way interested in the work. Full directions for mounting specimens will be sent when wanted. To preserve such specimens from destructive insects, it becomes necessary to poison them. This can be best done by a solution of corrosive sublimate, which can be applied to their bodies with a camel's hair pencil. It is best to use it as strong as may be without whitening the insects, but if too much is added and the specimen whitened, it is not spoiled; as it may be dissolved away with alcohol and thus restored. Insects may be killed by the inhalation of chloroform if desired, but for beetles and many other small insects their immediate immersion in alcohol, in which they can be kept for years, is the most desirable method for collectors. By this method a wide mouthed bottle which contains strong alcohol, in which specimens can be put as soon as caught, is all that is necessary. After they become fully saturated they can be taken out of the alcohol and sent by mail in a small box without any injury. But as butterflies and moths cannot be thus preserved, pinning is sometimes necessary. Great care should be taken that spec-

imens pinned should be perfect, that their wings be fully extended and their antennæ and limbs not allowed to curl up as they are inclined to do, but dried in as natural a position as possible. Constant care must be taken after the specimen is put up to preserve it. Though poisoned, it is not free from the depredations of some destructive insects, and must be kept in a close box. Dust is also a great injury, as well as light, so it is necessary to protect very nicely from all injuries. The chrysalis and caterpillar should also be preserved ; the latter can usually be preserved in alcohol.

## CONCHOLOGY.

An inland state like Vermont would seem a poor place for a local collection of shells, but it is by no means as deficient as it seems. I have been able already to collect many species, and many more can be collected. To those interested, I would say that I should like to have them collect in their localities ten shells of a kind, if possible, if not, as many as may be, marking distinctly where found. If they will send such collections to me for the use of the cabinet, I will return them named samples of their collection, and, as soon as may be, place the others in the cabinet, and to their credit if they wish, paying them in exchanges as soon as our collection is large enough to supply them. I should be glad to impress upon the public mind the great scientific value of such a local collection, and attract their attention to such an extent that persons finding shells in Vermont would save them and forward by their town representative to our cabinet.

## MINERALOGY.

In this department, as no geological survey is in progress, and no authorized expense could be incurred in the field, for the state no progress could really be made. I have, however,

added about two hundred specimens, many of them of interest, having comparative value, or new representations of Vermont minerals not previously in the cabinet; I have also re-arranged many specimens, preparing new labels, using new cases, and in every way trying to utilize the limited space allowed. It will become immediately necessary, if the specimens are all put on exhibition, to have more room. I trust such want will be considered by the next session of our legislature. In the meantime all collections made will be cared for and held in readiness for exhibition when space shall be given them. Let this fact deter no one from contributing thereto, as their contributions will be just as valuable and will at proper time be placed on exhibition in a favorable manner.

During the past year some mines in Vermont have been wrought with profit, and the marble interest was never larger or more profitable. At Gaysville, Saltery & Smith have inaugurated extensive gold washing, which they claim thus far profitable. As I have before expressed, it is still my opinion, if gold ever pays in Vermont it will be like this at Gaysville, from washing. Quartz mining in this section for gold has always been a failure; it is still my impression it ever will be. At the present high price of metals, if long continued, doubtless some mines in Vermont, now abandoned, might be wrought with profit, and perhaps some new veins now known may be opened, as well as other discoveries made. When metals are as now high priced, and in active demand, prospecting is usually prosecuted with more vigor and effect.

## ACKNOWLEDGMENTS.

Our acknowledgments to gentlemen in the State and out, who have aided us in various ways, should be numerous, but

only a few names can be mentioned. I would, however, make particular mention of Prof. Peter Collier, of Burlington, Hon. Charles Reed, and T. C. Phinney, of Montpelier, Prof. J. A. Allen, of Cambridge, Mass., Philip S. Sprague, of Boston, Mass., and J. H. Huntington, of Hanover, N. H.

Our thanks in behalf of the State are especially due to the management of the "Boston, Concord & Montreal and White Mts. R. R.," "Conn. & Pass. Rivers & Massawippi Valley R. R.," "Vermont Central R. R. and its branches," "Concord Railroad and its branches," "Boston, Lowell & Nashua R. R. and branches," and "Eastern Railroad and branches," for free passes over their lines of road.

Hoping that the interest universally expressed in favor of our Vermont scientific collection may increase, rather than diminish, and that the ready assistance redered us in our endeavors to obtain specimens of interest for this collection may continue, and the results produced be worthy of our "Green Mountain State,"

I am respectfully yours,

HIRAM A. CUTTING,

*State Geologist and Curator State Cabinet.*

Lunenburgh, Vt., November 18, 1872.

## LIST OF ILLUSTRATIONS.

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